N6736822

TEST REPORT

FOR

PRESSURE GAGES, 4.5-INCH

Helicoid Gage Division, American Chain and Cable Co.

Part Numbers 3956D, 3956M, and 3956T

Replacements for

NASA Drawing Numbers 75M50147-4, 75M50147-12, and 75M50147-18

ABSTRACT

This report presents the results of tests performed on six specimens with manufacturer's part numbers 3956D, 3956M, and 3956T to be used as replacements for NASA drawing numbers 75M50147-4, 75M50147-12 and 75M50147-18. The following tests were performed.

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Low Temperature
5. High Temperature
6. Vibration
7. Humidity
8. Sand and Dust
9. Salt Fog
10. Surge
11. Life Cycle
12. Final Inspection
13. Burst

Throughout the test program all six specimens demonstrated non-repeatability and required frequent calibration. None of the six specimens was temperature compensated, and consequently they did not meet the requirements of the high and low temperature tests. Readings for specimens 5 and 6 could be brought within tolerance only on points of increasing pressure.

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April 15, 1967

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS 8-4016, Part VII, CWO 271620.

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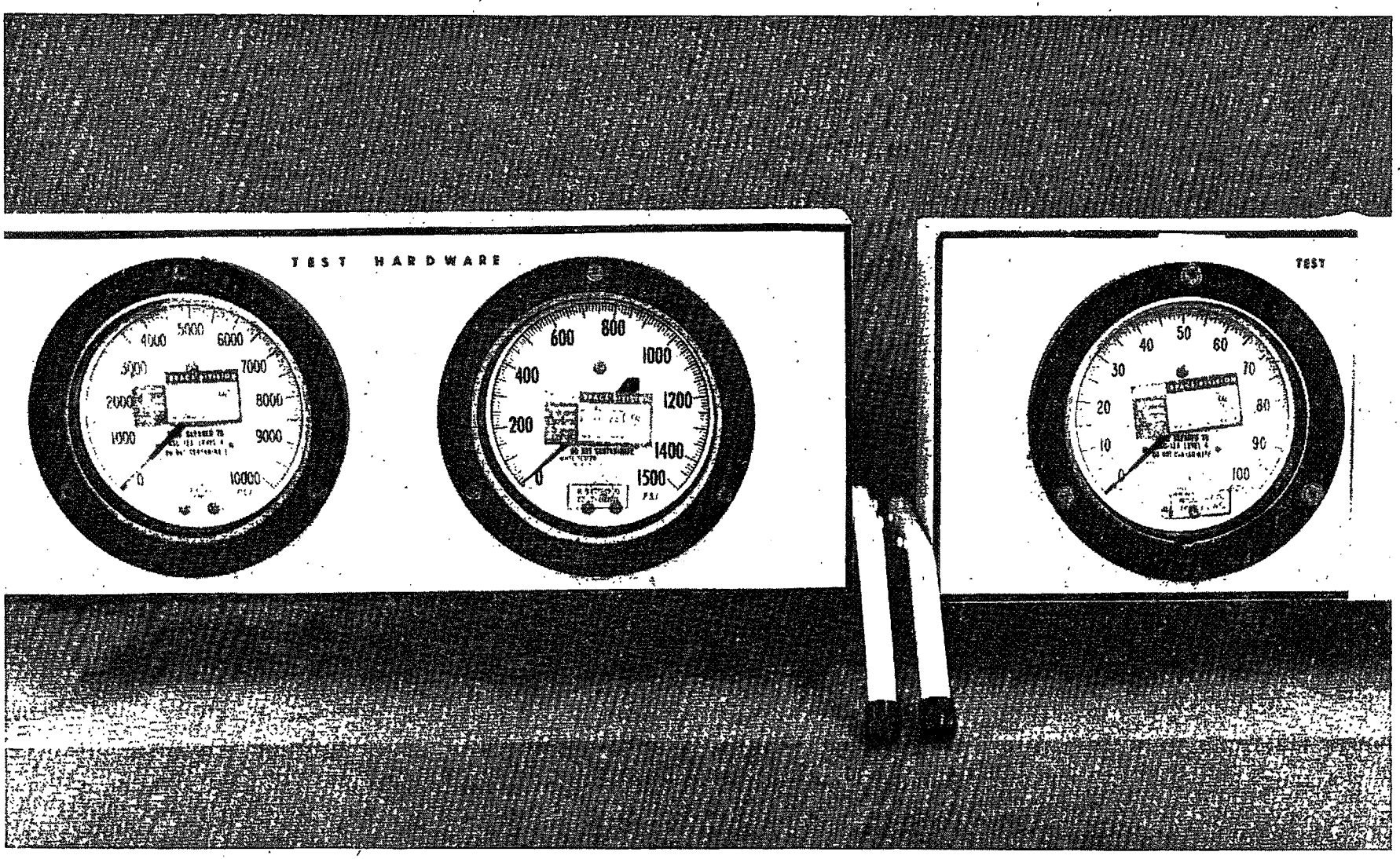


$4\frac{1}{2}$-Inch Pressure Gages

CHECK SHEET

FOR

4.5-INCH PRESSURE GAGES

MANUFACTURER: Helicoid Gage Division, American Chain and Cable Co.
MANUFACTURER'S PART NUMBERS: Type 440R (P/N 3956D, P/N 3956M, P/N 3956T)
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIUM:	Dry air, nitrogen, helium, or oxygen
B.	OPERATING PRESSURES:	0 to 100 psig (P/N 3956D), 0 to 1500 psig (P/N 3956M), 0 to 10,000 psig (P/N 3956T)
C.	LEAKAGE:	Bubble tight
D.	GAGE ACCURACY:	±0.5% of full scale
E.	PROOF PRESSURE:	100 psig (P/N 3956D), 1500 psig (P/N 3956M), 10,000 psig (P/N 3956T)
F.	BURST PRESSURE:	250 psig (P/N 3956D), 3750 psig (P/N 3956M), 15,000 psig (P/N 3956T)

II. CONSTRUCTION

A.	CASE MATERIAL:	Steel
B.	FINISH:	Baked black enamel over zinc dichromate
C.	COVER GLASS:	Shatterproof
D.	LUBRICATION:	KEL-F 10

III. ENVIRONMENTAL CHARACTERISTICS - MANUFACTURER'S SPECIFICATIONS

A.	OPERATING TEMPERATURE RANGE:	-65 to +165°F
B.	MAXIMUM DIAL RANGE:	0 to 100 psig (P/N 3956D), 0 to 1500 psig (P/N 3956M), 0 to 10,000 psig (P/N 3956T)

IV. SPECIAL REQUIREMENTS

A.	CLEANING SPECIFICATION:	A1OMO1671, level IV

V. LOCATION AND USE: Saturn IB, Launch Complexes 34 and 37 in the following equipment:

A. Pneumatic Control Distributor
B. Valve Panel 5
C. Valve Panel 9
D. Valve Panel 10
E. Deluge Purge Panel
F. Oxygen Conditioning System, Service Module Deluge Purge Panel

TEST SUMMARY FOR 4.5-INCH PRESSURE GAGES

Environment	Operational Boundary	Test Objective	Test Results						Remarks
			1	2	3	4	5	6	
Receiving Inspection	Drawings and specifications	To determine compliance with drawings and specifications	S	S	S	S	S	S	
Proof Pressure	Specimens 1 and 2: 100 psig Specimens 3 and 4: 1500 psig Specimens 5 and 6: 10,000 psig for 5 min	To check for leakage or structural damage	S	S	S	S	S	S	No leakage
Functional	Specimens 1 and 2: 0 to 100 to 0 psig, 1 min 20 psi increments Specimens 3 and 4: 0 to 1500 to 0 psig, 1 min at 300 psi increments Specimens 5 and 6: 0 to 10,000 to 0 psig, 1 min at 2000 psi increments	To determine accuracy against a standard gage and to determine leakage	S	S	S	S	S	S	
Low Temperature	-65°F	To determine if specimen operation is impaired by low temperature	U		U		U		Specimens were not temperature compensated
High Temperature	+165°F for 72 hours	To determine if specimen operation is impaired by high temperature	U		U		U		Specimens were not temperature compensated
Vibration	10g peak sinusoidal 0.01 g^2/cps random	To determine if specimen operation is impaired by vibration		S		S		S	

TEST SUMMARY FOR 4.5-INCH PRESSURE GAGES (CONTINUED)

Environment	Operational Boundary	Test Objective	Test Results						Remarks
			1	2	3	4	5	6	
Humidity	240 hours at 95% relative humidity	To determine if specimen operation is impaired after prolonged exposure to humidity	U		U		U		Specimens did not meet allowable tolerances when functionally tested after humidity test
Sand and Dust	2 hours, 77°F sand and dust at 0.1 to 0.25 gm/ft³ 100 to 500 ft/min	To determine if specimen operation is impaired after exposure to blown sand and dust	U		U		U		Specimens did not meet allowable tolerances when functionally tested after sand and dust; however, damage during shipping could have occurred
Salt Fog	240 hours atomized salt solution 95°F	To determine if specimen operation is impaired after exposure to salt fog	U		U		U		Specimens did not meet allowable tolerances during functional test following salt fog test
Surge	100 cycles 0 to 100 psig in 100 ms (Specimen 1), 0 to 1500 psig in 100 ms (Specimen 3), 0 to 10,000 psig in 100 ms (Specimen 5)	To determine if specimen operation is impaired by surge	S		S		U		Specimen 5 did not meet allowable tolerances during functional test following surge test
Life Cycle	40,000 cycles 0 to 80 psig in 5 seconds (Specimens 1 and 2), 0 to 1200 psig in 5 seconds (Specimens 3 and 4), 0 to 8000 psig in 5 seconds (Specimens 5 and 6)	To determine if specimen performance is impaired by operational cycling	U	U	U	U	U	U	Specimens did not meet allowable tolerances during functional tests performed during and after 40,000 life cycles
Final Inspection	NA	To note any visual effects of testing	S	S	S	S	S	S	

TEST SUMMARY FOR 4.5-INCH PRESSURE GAGES (CONTINUED)

Environment	Operational Boundary	Test Objective	Test Results						Remarks
			1	2	3	4	5	6	
Burst Pressure	Specimens 1 and 2: 250 psig minimum Specimens 3 and 4: 3750 psig minimum Specimens 5 and 6: 15,000 psig minimum	Pressurize until rupture	S	S	S	S	S	S	

SECTION I

INTRODUCTION

1.1 SCOPE

1.1.1 This report presents the results of tests that were performed to determine if Pressure Gages, part numbers 3956D, 3956M, and 3956T, are suitable replacements for part numbers 75M50147-4, 75M50147-12 and 75M50147-18, respectively, and if the gages meet the environmental and operational requirements for the John F. Kennedy Space Center Launch Complexes 34 and 37.

1.1.2 Three groups of gages, each group consisting of two gages of the same range, were subjected to testing. For convenience, the gages were identified as specimens 1 through 6.

1.2 ITEM DESCRIPTION

Each gage is 4.5 inches in diameter with a flush front mounting. Each has a shatterproof lens and a system bleed provision. Specimens 1 and 2, P/N 3956D, have a dial range of 0 to 100 psi; specimens 3 and 4, P/N 3956M, have a dial range of 0 to 1500 psi; and specimens 5 and 6, P/N 3956T, have a dial range of 0 to 10,000 psi. The gages may be used for dry air, nitrogen, helium, or oxygen. At KSC, the pressure gages are being considered for use in the pneumatic control distributor, valve panels 5, 9, and 10, the deluge purge panel, and the oxygen conditioning system service module deluge purge panel.

1.3 APPLICABLE DOCUMENTS

The documents used in this test are as follows:

a. B75M50147, Component Specification

b. KSC-STD-164(D), Environmental Test Methods

c. A1OMO1671, Cleanliness Requirements

d. Test Plan CCSD-FO-1003-1D, Test Requirements

e. TP-RE-CCSD-FO-1003-2D, Test Procedure

SECTION II

RECEIVING INSPECTION

2.1 REQUIREMENTS

2.1.1 The test specimen shall conform to the manufacturer's drawings 3956D, 3956M, and 3956T, and to the specifications on NASA drawing B75M50147.

2.2 PROCEDURE

2.2.1 Using the equipment listed in table 2-1, each specimen was visually and dimensionally inspected for conformance to the appropriate manufacturer's drawing 3956D, 3956M, or 3956T and to the specifications on NASA drawing B75M50147. At the same time the test specimen was also inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

2.3.1 Specimens 1 through 6 complied dimensionally with the appropriate manufacturer's part number 3956D, 3956M, or 3956T and with the specifications on NASA drawing B75M50147. There was no evidence of poor workmanship or manufacturing defects.

2.4 TEST DATA

The data are presented in table 2-2.

Table 2-1. Receiving Inspection Equipment List

Item No.	Item	Manufacturer	Part No.	Serial No.	Remarks
1	Scale	Brown and Sharpe	599-300 -2404	BT 08-113-101-1013	Initial cal date 7-23-64 0 to 24 inches

Table 2-2. Receiving Inspection Test Data

	Specimen Dimensions (inches)						
	Specification ±1/16	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Specimen 6
Serial Number		6020001	6020003	6020005	6020006	6020007	6020008
Outside Diameter	5.875	5.875	5.875	5.875	5.875	5.875	5.875
Backplate Diameter	4.813	4.813	4.75	4.75	4.75	4.75	4.75
Total Thickness	2.422	2.422	2.422	2.422	2.422	2.422	2.422
Back Section Thickness	1.969	1.969	1.938	1.969	1.969	1.969	1.969
Bolt Circle Diameter	5.375	5.375	5.375	5.375	5.375	5.375	5.375

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 Test specimens 1 and 2 shall be subjected to a proof pressure of 100 psig and remain bubble tight. Test specimens 3 and 4 shall be subjected to a proof pressure of 1500 psig and remain bubble tight. Test specimens 5 and 6 shall be subjected to a proof pressure of 10,000 psig and remain bubble tight.

3.1.2 The pressurizing medium shall be GN_2.

3.1.3 Proof pressure shall be maintained for five minutes.

3.2 TEST PROCEDURE

3.2.1 The proof pressure test setup was assembled as shown in figures 3-1 and 3-2 using the equipment listed in table 3-1.

3.2.2 Specimens 1 and 2 (item 1), gage saver 11 and gage 4 were included in the test setup.

3.2.3 Regulator 7 was adjusted for zero outlet pressure. Hand valve 8 was closed. Hand valve 15 was opened.

3.2.4 Hand valve 12 was slowly opened. Gage 16 indicated approximately 3000 psig. Gage saver 11 had been previously set at 102 psig.

3.2.5 Regulator 7 was adjusted until 100 psig was indicated on gage 4.

3.2.6 Hand valve 15 was closed. The specimen indication was recorded and the leakage monitored. Pressure was maintained for 5 minutes.

3.2.7 Regulator 7 was adjusted for zero outlet pressure, and hand valves 8 and 15 were opened to vent the specimen.

3.2.8 Specimens 3 and 4 (item 2), gage saver 13 and gage 5 were installed in the test setup to replace specimens 1 and 2, gage saver 11, and gage 4.

3.2.9 Hand valve 8 was closed. Regulator 7 was adjusted until 1500 psig was indicated on gage 5. Gage saver 13 had been previously set at 1520 psig.

3.2.10 Hand valve 15 was closed. Pressure was maintained for 5 minutes, and the specimen indication was recorded and the leakage monitored. Hand valve 15 was opened. Regulator 7 was adjusted for zero outlet pressure, hand valve 8 was opened, and the specimen was vented.

3.2.11 Specimens 5 and 6 (item 3), and gage 6 were installed in the test setup to replace specimens 3 and 4 and gage 5. Gage saver 13 was removed from the test setup. The supply pressure, as indicated on gage 16, was increased to 10,000 psig.

3.2.12 Regulator 7 was adjusted until 10,000 psig was indicated on gage 6.

3.2.13 Hand valve 15 was closed. Regulator 7 was adjusted for zero outlet pressure, hand valves 15 and 8 were opened, and the specimen was vented. Pressure was maintained for 5 minutes. Specimen indication was recorded and the leakage monitored.

3.2.14 Data were recorded.

3.3 TEST RESULTS

3.3.1 Specimens 1, 2, 3, 5, and 6 showed no evidence of leakage during the 5 minutes of pressurization.

3.3.2 Specimen 4 leaked at the approximate rate of 2 psig/minute. The specimen was returned to the vendor for repair. No leakage was evident after repairs were made.

3.4 TEST DATA

3.4.1 The data presented in table 3-2 were recorded during proof pressure testing.

Table 3-1. Proof Pressure and Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Division	3956D	6020001	0-to 100-psig ±0.5% FS
2	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Division	3956M	6020003 6020005	0-to 1500-psig ±0.5% FS
3	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Division	3956T	6020006 6020007	0-to 10,000-psig ±0.5% FS
4	Gage, Pressure (Calibrated)	Heise	NA	BT 08-113-95-1409B	0-to 100-psig ±0.1% FS Cal date 6-10-66
5	Gage, Pressure (Calibrated)	Heise	H45311	BT-95-1569-B	0-to 1500-psig ±0.1% FS Cal date 6-10-66
6	Gage, Pressure (Calibrated)	Heise	NA	BT 012952	0-to 10,000-psig ±0.1% FS Cal date 6-18-66
7	Regulator, Hand Loaded	Grove	MOD 18	L45106	Outlet pressure 0-to 10,000-psig
8	Valve, Hand	Robbins Aviation	SSKG-250-4T	NA	1/4-inch
9	Filter	Microporous	4813F-2DM	NA	2-micron
10	GN_2 Pressure Source	NA	NA	NA	3000-psig (except 10,000-psig for specimens 5 and 6)
11	Gage Saver	Republic Mfg. Co.	680-1D2	NA	15-to 250-psig
12	Valve, Hand	Combination Pump and Valve Co.	PL-673	NA	1½-inch
13	Gage Saver	Republic Mfg. Co.	680-3D2	NA	1000-to 5000-psig
14	Temperature Chamber	Conrad	NA	NA	-65 to +165°F (required for temperature test only)

Table 3-1. Proof Pressure and Functional Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
15	Valve, Hand	Robbins Aviation	SSKG-250-4T	NA	1/4-inch
16	Gage, Pressure	Ashcroft	NA	NA	0-to 20,000-psig ±2% FS Cal date 4-13-66

Table 3-2. Proof Pressure Test Data

Specimen	Proof Pressure (psig)	Pressurization Time (min)	Remarks
1	100.0	5	No leakage
2	100.0	5	No leakage
3	1500	5	No leakage
4	1500	5	Leaked initially no leakage after repair
5	10,000	5	No leakage
6	10,000	5	No leakage

Note: All lines ¼ inch.
Refer to table 3-1 for item identification.

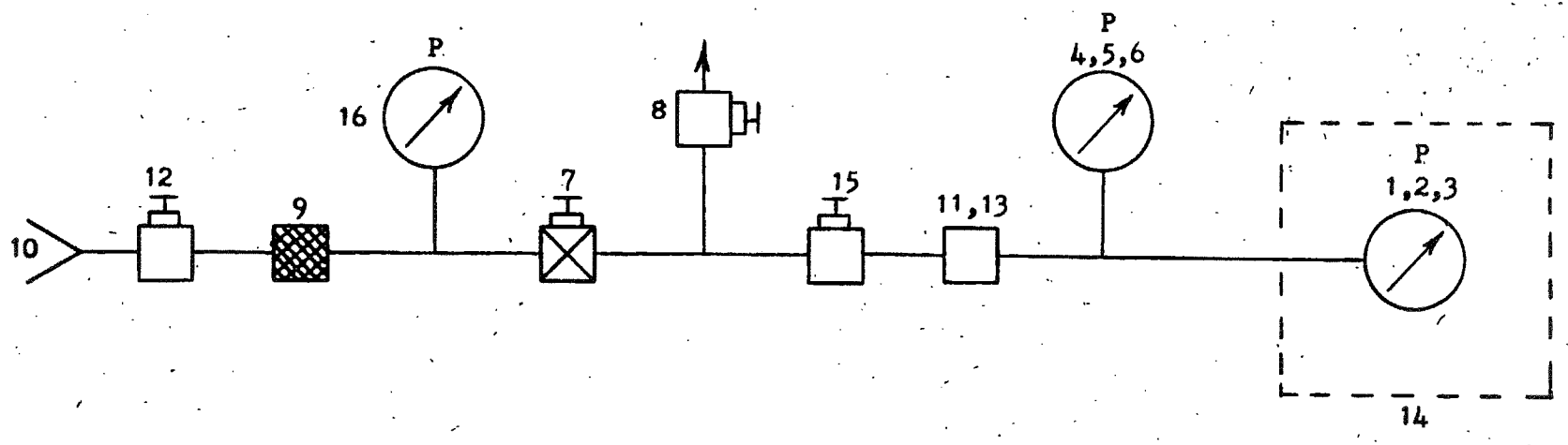


Figure 3-1. Proof Pressure and Functional Test Schematic

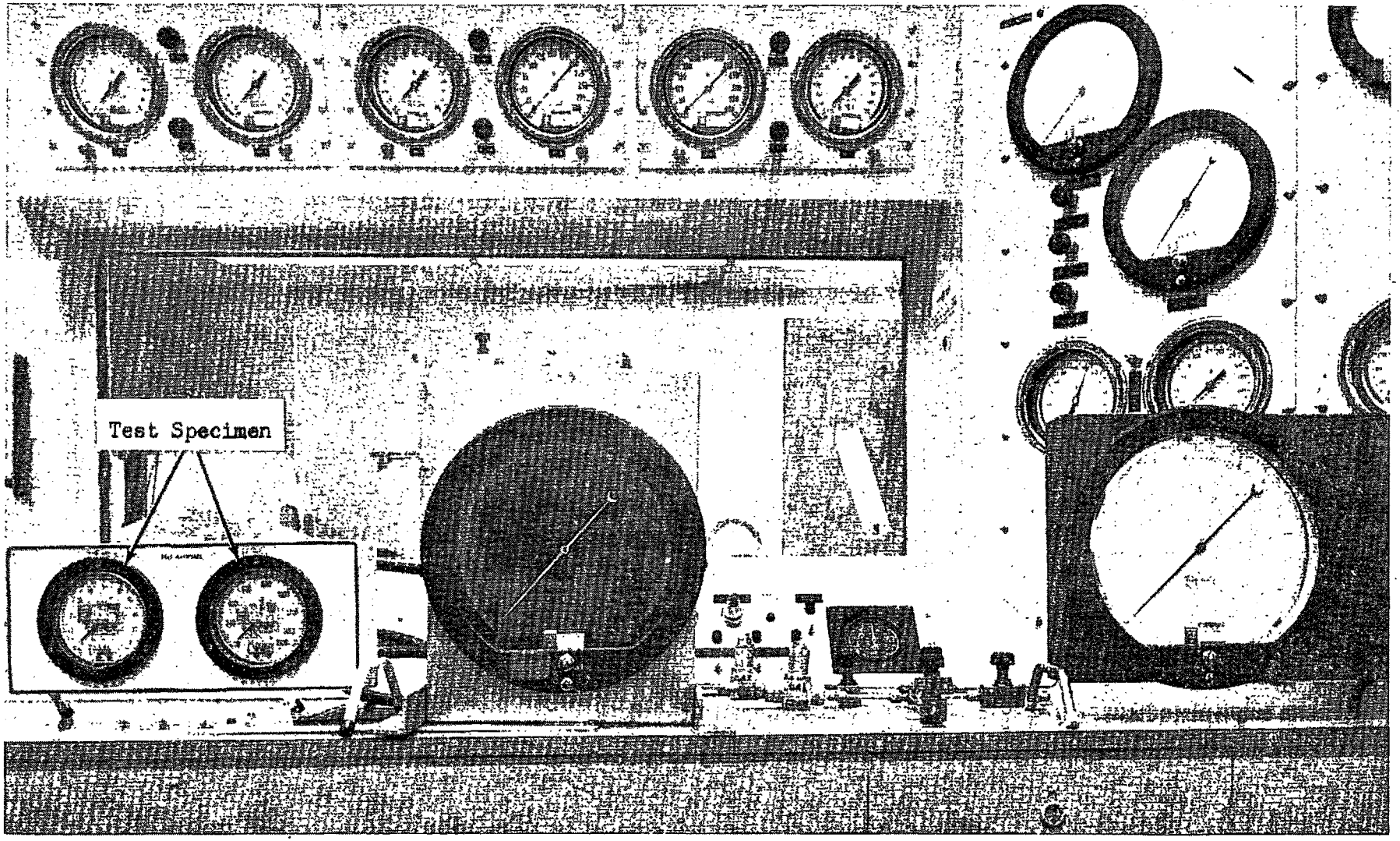


Figure 3-2. Proof Pressure and Functional Test Setup

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 Test specimens 1 and 2 shall be pressurized with GN_2 from zero to maximum dial range with a one minute dwell at settings of 20, 40, 60, 80, and 100 psig. The pressure shall be decreased from maximum dial range to zero with a one minute dwell at settings of 80, 60, 40, and 20 psig.

4.1.2 Test specimens 3 and 4 shall be pressurized with GN_2 from zero to maximum dial range with a one minute dwell at settings of 300, 600, 900, 1200, and 1500 psig. The pressure shall be decreased from maximum dial range to zero with a one minute dwell at settings of 1200, 900, 600, and 300 psig.

4.1.3 Test specimens 5 and 6 shall be pressurized with GN_2 from zero to maximum dial range with a one minute dwell at settings of 2000, 4000, 6000, 8000, and 10,000 psig. The pressure shall be decreased from maximum dial range to zero with a one minute dwell at settings of 8000, 6000, 4000, and 2000 psig.

4.1.4 The pressure gages must be bubble tight and have an accuracy of $\pm 0.5\%$ of full scale.

4.2 TEST PROCEDURE

4.2.1 Specimens 1, 2, 3, 4, 5, and 6 were adjusted for proper calibration by the CCSD Metrology Laboratory. Only the increasing pressure readings were adjusted.

4.2.2 The test setup was assembled as shown in figures 3-1 and 3-2 using the equipment listed in table 3-1.

4.2.3 Specimens 1 and 2 (item 1), gage saver 11, and gage 4 were installed to the test setup.

4.2.4 Regulator 7 was adjusted for zero outlet pressure. Hand valve 8 was closed.

4.2.5 Hand valve 12 was slowly opened. Gage 16 indicated approximately 3000 psig. Gage saver 11 had been previously set at 102 psig.

4.2.6 Regulator 7 was adjusted until 20.0 psig was indicated on gage 4.

4.2.7 Hand valve 15 was closed. Specimen indication was recorded after one minute stabilization time. Leakage was monitored and hand valve 15 was opened.

4.2.8 Pressure was increased until readings of 40, 60, 80, and 100 psig were indicated on gage 4 by using the procedures described in 4.2.6 and 4.2.7.

4.2.9 Pressure was decreased until readings of 80, 60, 40, and 20 psig were indicated on gage 4 by using the procedures described in 4.2.6 and 4.2.7.

4.2.10 Specimens 3 and 4 (item 2), gage saver 13 and gage 5 were installed in the test setup to replace specimens 1 and 2, gage saver 14 and gage 4.

4.2.11 Regulator 7 was adjusted until 300 psig was indicated on gage 5.

4.2.12 Hand valve 15 was closed. Specimen indication was recorded after one minute stabilization time. Leakage was monitored and hand valve 15 was opened.

4.2.13 Pressure was increased until readings of 600, 900, 1200 and 1500 psig were indicated on gage 5 by using the procedures described in 4.2.11 and 4.2.12.

4.2.14 Pressure was decreased until readings of 1200, 900, 600, and 300 psig were indicated on gage 5 by using the procedures described in 4.2.11 and 4.2.12.

4.2.15 Specimens 5 and 6 (item 3) and gage 6 were installed in the test setup to replace specimens 3 and 4 and gage 5. Gage saver 13 was removed from the setup. The supply pressure, as read on gage 16, was increased to 10,000 psig.

4.2.16 Regulator 7 was adjusted until 2000 psig was indicated on gage 6.

4.2.17 Hand valve 15 was closed. Specimen indication was recorded after one minute stabilization time. Leakage was monitored and hand valve 15 was opened.

4.2.18 Pressure was increased until readings of 4000, 6000, 8000, and 10,000 psig were indicated by gage 6 by using the procedures described in 4.2.16 and 4.2.17.

4.2.19 Pressure was decreased until readings of 8000, 6000, 4000 and 2000 psig were indicated by gage 6 using the procedures described in 4.2.16 and 4.2.17.

4.2.20 All data were recorded.

4.3 TEST RESULTS

4.3.1 Test specimens 1, 2, 3, 4, 5, and 6 showed no evidence of leakage during the functional tests.

4.3.2 Specimens 1, 2, 3, and 4 indicated readings which were within the prescribed 0.5% FS range. Specimen 5 indicated two readings which were out of the 0.5% FS range and specimen 6 indicated one reading out of the 0.5% FS range.

4.3.3 Consideration was given to the $\pm$0.1% full scale tolerance of the standard gage in evaluating functional performance.

4.4 TEST DATA

Data recorded during the initial functional test are presented in table 4-1.

Table 4-1. Functional Test Data

Specimens 1 and 2			Specimens 3 and 4			Specimens 5* and 6*		
Standard Gage Reading (psig) ±0.1% FS	Gage Reading (psig) ±0.5% FS		Standard Gage Reading (psig) ±0.1% FS	Gage Reading (psig) ±0.5% FS		Standard Gage Reading (psig) ±0.1% FS	Gage Reading (psig) ±0.5% FS	
	Specimen 1 S/N 6020001	Specimen 2 S/N 6020003		Specimen 3 S/N 6020005	Specimen 4 S/N 6020006		Specimen 5 S/N 6020007	Specimen 6 S/N 6020008
20.0	19.5	19.7	300	292	299	2000	2015	2020
40.0	39.6	39.7	600	595	601	4000	3980	4010
60.0	60.0	59.7	900	899	906	6000	5970	6000
80.0	80.0	79.7	1200	1195	1203	8000	7990	8000
100.0	99.9	99.9	1500	1494	1499	10000	9972	10000
80.0	80.1	79.8	1200	1200	1207	8000	7937	8010
60.0	60.4	59.9	900	903	908	6000	5955	6090
40.0	40.0	39.9	600	599	607	4000	3930	4060
20.0	19.9	19.8	300	295	300	2000	1975	2040

* Specimens were calibrated to increasing pressure only.

SECTION V

LOW TEMPERATURE TEST

5.1 TEST REQUIREMENTS

5.1.1 Test specimens 1, 3, and 5 shall be subjected to -65°F in a low temperature test.

5.1.2 The test specimens shall be functionally tested when a stabilized temperature of -65°F is reached.

5.1.3 After returning to room ambient conditions, the gages shall be visually inspected, and a functional test shall be conducted within one hour after the test specimen has reached room ambient conditions.

5.2 TEST PROCEDURE

5.2.1 The low temperature test setup was assembled as shown in figures 3-1 and 5-1 utilizing the equipment listed in table 3-1.

5.2.2 A functional test was performed prior to beginning the low temperature test where 72 hours or more had elapsed since the previous functional test.

5.2.3 Specimen 1, gage saver 11, and gage 4 were placed in the test setup.

5.2.4 The chamber was controlled to the specified test conditions while maintaining a relative humidity between 60 and 90 per cent.

5.2.5 A functional test was performed when temperature stabilization was obtained at -65°F. Temperature stabilization was defined as a maximum temperature change rate of 4°F per hour as determined from the instrumentation monitoring the test specimen.

5.2.6 The chamber was adjusted and allowed to stabilize at -45°F, -25°F, -5°F, +15°F, +35°F, and +55°F. A functional test was performed on the specimen at each of the temperatures.

5.2.7 The specimen was returned to ambient conditions. A visual inspection and functional test was performed on the specimen within 1 hour following the return of the specimen to ambient conditions.

5.2.8 Specimen 1, gage saver 11, and gage 4 were replaced by specimen 3, gage saver 13, and gage 5 in the test setup.

5.2.9 Procedures 5.2.4 through 5.2.7 were repeated, performing the functional test as applicable for specimen 3.

5.2.10 Specimen 3 and gage 5 were replaced by specimen 5 and gage 6. Gage saver 13 was removed from the test setup.

5.2.11 Procedures 5.2.4 through 5.2.7 were repeated, performing the functional test as applicable for specimen 5.

5.2.12 All data were recorded.

5.3 TEST RESULTS

5.3.1 During functional tests performed at the rated low temperature of -65°F, specimens 1, 3, and 5 indicated a significant shift in readings as compared to pressure readings taken prior to the low temperature test.

5.3.2 In an effort to obtain more data, functional tests were performed at -45°F, -25°F, -5°F, +15°F, +35°F and +55°F.

5.4 TEST DATA

Data for specimens 1, 3 and 5 are presented in tables 5-1, 5-2, and 5-3.

Table 5-1. Low Temperature Functional Test Data, Specimen 1

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings ±0.5% FS								
	Preceding Test At 82°F	Temperature (°F)							Following Test At 81°F
		-65	-45	-25	-5	+15	+35	+55	
20.0	20.0	19.1	18.9	19.2	19.7	19.8	19.9	20.0	20.0
40.0	40.0	38.7	38.9	39.3	39.4	39.6	39.7	40.0	40.0
60.0	60.0	58.0	58.5	58.7	59.2	59.4	59.6	59.9	60.0
80.0	80.1	77.4	78.0	78.5	78.8	79.2	79.5	79.8	79.9
100.0	100.0	96.5	97.3	97.7	98.3	98.8	99.1	99.6	99.9
80.0	80.1	78.5	78.2	78.6	78.9	79.4	79.5	80.0	80.0
60.0	60.0	58.2	58.5	58.9	59.1	59.5	59.6	60.0	60.0
40.0	39.9	39.0	39.3	39.5	39.6	39.6	40.0	40.1	40.0
20.0	19.9	19.2	19.5	19.7	19.9	20.0	20.1	20.3	20.0

Table 5-2. Low Temperature Functional Test Data, Specimen 3

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings ±0.5% FS								
	Preceding Test At 76°F	Temperature (°F)							Following Test At 82°F
		-65	-45	-25	-5	+15	+35	+55	
300	292	293	290	290	290	289	292	293	295
600	595	582	582	585	585	590	592	592	597
900	899	878	882	882	888	890	894	898	900
1200	1195	1165	1170	1171	1174	1181	1186	1192	1196
1500	1494	1454	1458	1463	1470	1478	1480	1490	1497
1200	1200	1168	1170	1175	1175	1182	1188	1192	1200
900	903	881	885	888	889	895	896	901	903
600	599	585	590	589	590	594	595	599	600
300	295	294	295	294	295	298	293	297	296

Table 5-3. Low Temperature Functional Test Data, Specimen 5

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings ±0.5% FS								
	Preceding Test At 81°F	Temperature (°F)							Following Test At 76°F
		-65	-45	-25	-5	+15	+35	+55	
2000	2000	1970	1999	200	2000	2010	2000	2000	2000
4000	4020	3910	3960	3980	4000	4000	3990	4000	4000
6000	6040	5860	5900	5940	5950	5990	6000	6000	6010
8000	8050	7760	7850	7870	7900	7960	7975	8000	8040
10000	10000*	9770	9800	9850	9900	9950	9960	10000**	10000***
8000	8100	7860	7910	7940	7960	8010	8200	8060	8090
6000	6130	5950	5975	6020	6010	6100	6000	6075	6110
4000	4090	4000	4010	4050	4050	4075	4060	4060	4090
2000	2060	2040	2050	2050	2075	2080	2060	2060	2050

* Standard gage indicated 9910 psig
** Standard gage indicated 9985 psig
*** Standard gage indicated 9980 psig

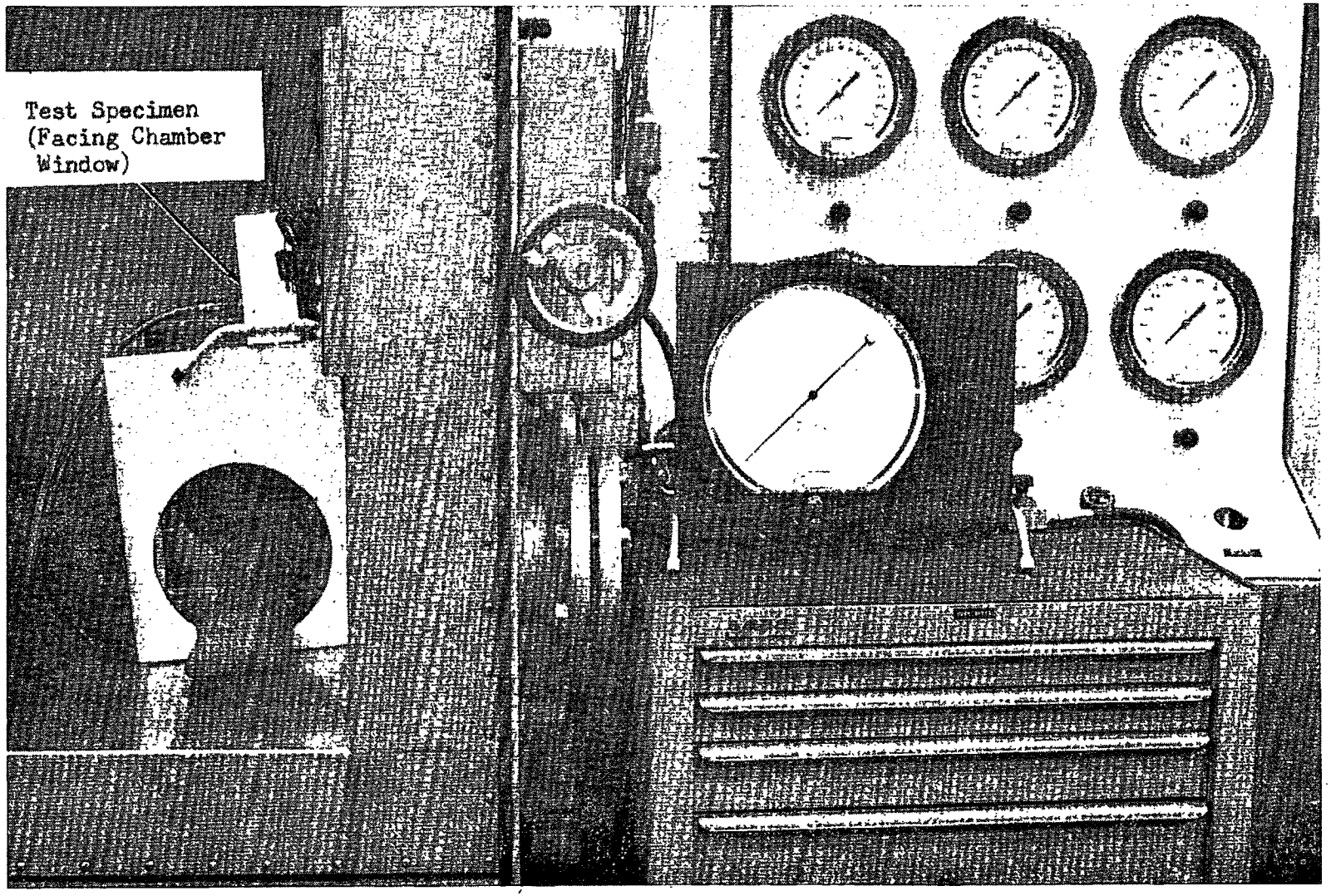


Figure 5-1. Low and High Temperature Test Setup

SECTION VI

HIGH TEMPERATURE TEST

6.1 TEST REQUIREMENTS

6.1.1 Test specimens 1, 3, and 5 shall be subjected to +165°F for a period of 72 (+2, -0) hours.

6.1.2 A functional test shall then be performed at 165°F.

6.1.3 Within one hour after returning to room ambient conditions, the pressure gages will be visually inspected and functionally tested.

6.2 TEST PROCEDURE

6.2.1 The high temperature test setup was assembled as shown in figures 3-1 and 5-1 utilizing the equipment listed in table 3-1.

6.2.2 A functional test was performed prior to beginning the low temperature test where 72 hours or more had elapsed since the previous functional test.

6.2.3 Specimen 1, gage saver 11, and gage 4 were placed in the test setup.

6.2.4 The chamber was controlled to the specified test conditions, maintaining a relative humidity of 20 ($\pm$5) per cent.

6.2.5 The stabilized temperature of 165 (+4, -0)°F was maintained for 72 (+2, -0) hours.

6.2.6 While at 160°F, the specimen was subjected to a functional test as applicable to the specimen pressure range.

6.2.7 The chamber was adjusted and allowed to stabilize at 145, 125 and 105°F. A functional test as applicable to the specimen pressure range was performed at each of these temperatures.

6.2.8 The chamber was returned to room ambient conditions. A visual inspection and a functional test was performed on the test specimen, as applicable to the specimen pressure range, within one hour following the return of the specimen to ambient conditions.

6.2.9 Specimen 1, gage saver 11 and gage 4 were replaced by specimen 3, gage saver 13 and gage 5 in the test setup.

6.2.10 Procedures 6.2.4 through 6.2.8 were repeated, performing the functional test as applicable to the specimen pressure range.

6.2.11 Specimen 3 and gage 5 were replaced by specimen 5 and gage 6. Gage saver 13 was removed from the test setup.

6.2.12 Procedures 6.2.4 through 6.2.8 were repeated, performing the functional as applicable to the specimen pressure range.

6.2.13 Data were recorded.

6.3 TEST RESULTS

6.3.1 During the functional test performed at the rated high temperature of 165°F, specimens 1, 3 and 5 indicated a significant shift in readings as compared to pressure readings taken prior to the high temperature test.

6.3.2 In an effort to obtain more data, functional tests were performed at +145, +125 and +105°F.

6.4 TEST DATA

Data for specimens 1, 3 and 5 are presented in tables 6-1, 6-2 and 6-3.

Table 6-1. High Temperature Functional Test Data, Specimen 1

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings ±0.5% FS					
	Preceding Test at 75°F	Temperature (°F)				Following Test at 76.5°F
		+165	+145	+125	+105	
20.0	19.4	19.0	19.1	19.1	19.4	19.2
40.0	39.5	39.6	36.6	39.6	39.7	40.0
60.0	59.6	60.25	60.1	60.0	59.9	59.6
80.0	79.5	80.55	80.5	80.1	80.0	79.7
100.0	99.4	100.0	100.0	100.0	100.0	99.4
80.0	80.0	81.3	80.9	80.6	80.1	80.0
60.0	60.1	60.75	60.5	60.25	60.1	60.0
40.0	40.0	40.5	40.3	40.2	40.0	40.0
20.0	20.0	19.9	19.9	19.9	20.0	19.8

Table 6-2. High Temperature Functional Test Data, Specimen 3

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings ±0.5% FS					
	Preceding Test at 80°F	Temperature (°F)				Following Test at 78°F
		+165	+145	+125	+105	
300	295	291	291	292	291	295
600	600	596	599	600	596	598
900	900	901	900	900	895	900
1200	1194	1202	1204	1195	1191	1196
1500	1493	1500	1500*	1500	1500	1490
1200	1201	1216	1211	1209	1200	1200
900	905	914	911	908	902	905
600	607	610	610	609	605	605
300	302	300	300	300	300	300

* Standard gage indicated 1490.

Table 6-3. High Temperature Functional Test Data, Specimen 5

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings ±0.5% FS					
	Preceding Test at 76°F	Temperature (°F)				Following Test at +76°F
		+165	+145	+125	+105	
2000	2000	1965	1975	1950	1965	1975
4000	4000	4000	4000	4000	4000	4000
6000	6010	6060	6040	6035	6045	6025
8000	8040	8120	8095	8065	8050	8000
10000	10000*	9875	---	---	---	---
8000	8090	8150	8260	8150	8135	8070
6000	6110	6150	6150	6150	6135	8015
4000	4090	4050	4100	4060	4090	4095
2000	2050	2000	2000	2000	2045	2050

* Standard gage indicated 9980.

SECTION VII

VIBRATION TEST

7.1 TEST REQUIREMENTS

7.1.1 A vibration test shall be performed on test specimens 2, 4, and 6. Each specimen shall be pressurized to 50 per cent of full scale during all periods of vibration. The test shall be performed in accordance with KSC-STD-164(D), section 9, figures 9-1 and 9-2, level D.

7.1.1.1 Resonant Frequency Search. The fixture/test specimen assembly shall be exposed to sinusoidal vibration in the X-axis at the input levels shown in table 7-1. A frequency range of 5 to 3000 cps shall be traversed logarithmically in directions of both increasing and decreasing frequency over a time period not to exceed 15 minutes per axis. Actual time shall be noted. All fixture and test specimen resonant frequencies and the structural member in resonance shall be noted. In addition, critical frequencies of the test specimen shall be noted. Critical frequencies are defined as those frequencies at which functional degradation occurs.

Table 7-1. Resonant Frequency Search Levels

Frequency (cps)	Displacement (D.A. inch)	Acceleration (g)
5 to 45	0.01	--
45 to 3000	--	1

7.1.1.2 Sinusoidal Sweep. In one 20-minute sweep, with the specimen still in the X-axis, the frequency range shall be scanned logarithmically from 10 to 2000 cps and back to 10 cps. Critical frequencies of the test specimen shall be noted. The test item shall be functionally tested after this test has been completed. The sinusoidal sweep input levels shall be as shown in table 7-2.

Table 7-2. Sinusoidal Sweep Vibration Levels

Frequency (cps)	Displacement (D.A. inch)	Acceleration (g)
10 to 45	0.1	--
45 to 2000	--	10

Upon completion of the sine sweep in the X axis, proceed directly to the random excitation.

7.1.1.3 Random Excitation. The test specimen shall be exposed to random vibration at the specified levels over a frequency range from 10 to 2000 cps for a period of 5 minutes. The test specimen shall be slowly pressurized to the maximum dial range (or 6000 psig for specimen 6) and then back to zero during random exposure. The test specimen shall be functionally tested after this test has been completed. The specified random input levels shall be as shown in table 7-3.

Table 7-3. Random Excitation Vibration Levels

Frequency (cps)	Slope (db/octave)	PSD (g^2/cps)
10 to 100	+6	—
100 to 1000	—	0.01
1000 to 2000	-6	—

7.1.2 Acceleration shall be measured at the test specimen by accelerometers mounted on the specimen. The control accelerometer shall be mounted on the test fixture.

7.1.3 Repeat paragraphs 7.1.1.1 through 7.1.1.3 for the Y and Z axes, respectively.

7.2 TEST PROCEDURE

7.2.1 The test specimen was mounted on the vibration system for vibration in the X-axis as shown in figures 7-1 and 7-2 using the equipment listed in table 7-1.

7.2.2 All hand valves and regulators were adjusted for zero outlet pressure.

7.2.3 Hand valve 17 was opened and the supply pressure was indicated on gage 18.

7.2.4 Hand valve 19 was opened.

7.2.5 Regulator 6 was adjusted to provide pressure equal to 50 per cent specimen dial range as indicated on gage 4, 5, or 6.

7.2.6 The conditions specified in 7.2.5 were maintained during all periods of vibration. Hand valve 19 was closed. Any changes in specimen pressure indications were noted.

7.2.7 Resonant Frequency Search

7.2.7.1 A frequency range of 5 to 3000 cps was traversed logarithmically in directions of both increasing and decreasing frequency over a time period of 15 minutes per axis. Input levels are shown in table 7-1.

7.2.7.2 All fixture and test item resonant frequencies were recorded.

7.2.8 Sinusoidal Sweep Test

7.2.8.1 Whenever 72 hours or more had elapsed since a previous functional test had been performed, the specimen was functionally tested as applicable for the specimen pressure range.

7.2.8.2 The frequency range was scanned logarithmically from 10 to 2000 cps and back to 10 cps over a time period of 20 minutes. Input levels are shown in table 7-2.

7.2.8.3 Critical frequencies were monitored.

7.2.8.4 A functional test was performed upon completion of the sinusoidal sweep test.

7.2.9 Random Excitation Test

7.2.9.1 The procedure described in 7.2.8.1 was repeated.

7.2.9.2 The specimen was subjected to random excitation for 5 minutes. The specified random input levels are shown in table 7-3.

7.2.9.3 A functional test was performed on the specimen upon completion of the random excitation test.

7.2.10 The procedures described in 7.2.1 through 7.2.9.3 were repeated for vibration testing in the Y and Z axes using applicable functional equipment for each pressure range. Whenever possible two specimens were tested simultaneously.

7.2.11 Test data were recorded.

7.3 TEST RESULTS

7.3.1 Specimens 2, 4, and 6 indicated changes in pressure readings recorded from functional tests performed during the vibration tests.

7.3.2 It could not be determined whether the shifts in pressure indications observed during the vibration tests were the direct result of the dynamic environment or a demonstration of the non-repeatability of the specimens.

7.4 TEST DATA

Data for specimens 2, 4 and 6 taken during the vibration test are presented in tables 7-5, 7-6 and 7-7.

Table 7-4. Vibration Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956D	6020003	0-to 100-psig ±0.5% FS
2	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956M	6020006	0-to 1500-psig ±0.5% FS
3	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956T	6020008	0-to 10,000-psig ±0.5% FS
4	Gage, Pressure (Calibrated)	Heise	NA	NASA 014227	0-to 100-psig ±0.1% FS Cal date 10/13/66
5	Gage, Pressure (Calibrated)	Heise	NA	NASA 95-1569-B	Dial Range: 0 to 1500 psig ±0.1% FS Cal date 10/13/66
6	Gage, Pressure (Calibrated)	Heise	NA	NASA 014231	0-to 10,000 psig ±.1% FS Cal date 10/13/66
7	Regulator, Hand Loaded	Tescom	26-1002	1010	Outlet pressure 0-to 10,000-psig
8	Valve, Hand	Robbins Aviation Inc.	SSKG-250-4T	NA	1/4 inch
9	Control Accelerometer	Endevco	2233	NASA 97-1026-B	5 to 3000 cps accuracy: ±3.5% amplitude ±1.5% frequency (2 cps min) Cal date 10/16/66
10	Accelerometer	Endevco	2220	NASA 95-1129-B	5 to 3000 cps accuracy: ±3.5% amplitude ±1.5% frequency (2 cps. Min)

Table 7-4. Vibration Test Equipment List (Cont.)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
					Cal date 10/18/66
11	Vibration System	MB	C125	NA	To provide: 10g 5 to 3000 cps
12	Vibration Fixture	CCSD	NA	NA	606/-T6 Aluminum
13	Filter	Fluid Dynamics Inc.	FL-02-8BB	NA	2-micron
14	GN_2 Pressure Source	CCSD	NA	NA	6000-psig
15	Flex Hose	Resistoflex	NA	NA	1/4-inch
16	Gage Saver	Republic Mfg.Co.	680-3D2	NA	1000 to 5000 psig (for specimen 4)
		Republic Mfg.Co.	680-1D2	NA	15 to 250 psig (for specimen 2)
17	Hand Valve	Robbins Aviation Inc.	SSKG-250-4T	NA	1/4-inch
18	Gage	Heise	NA B/T015536	7	0-to 5000-psig ±0.1% GS Cal date 10/18/66
19	Hand Valve	Robbins Aviation Inc.	SSKG-250-4T		1/4-inch

Table 7-5. Vibration Functional Test Data, Specimen 2

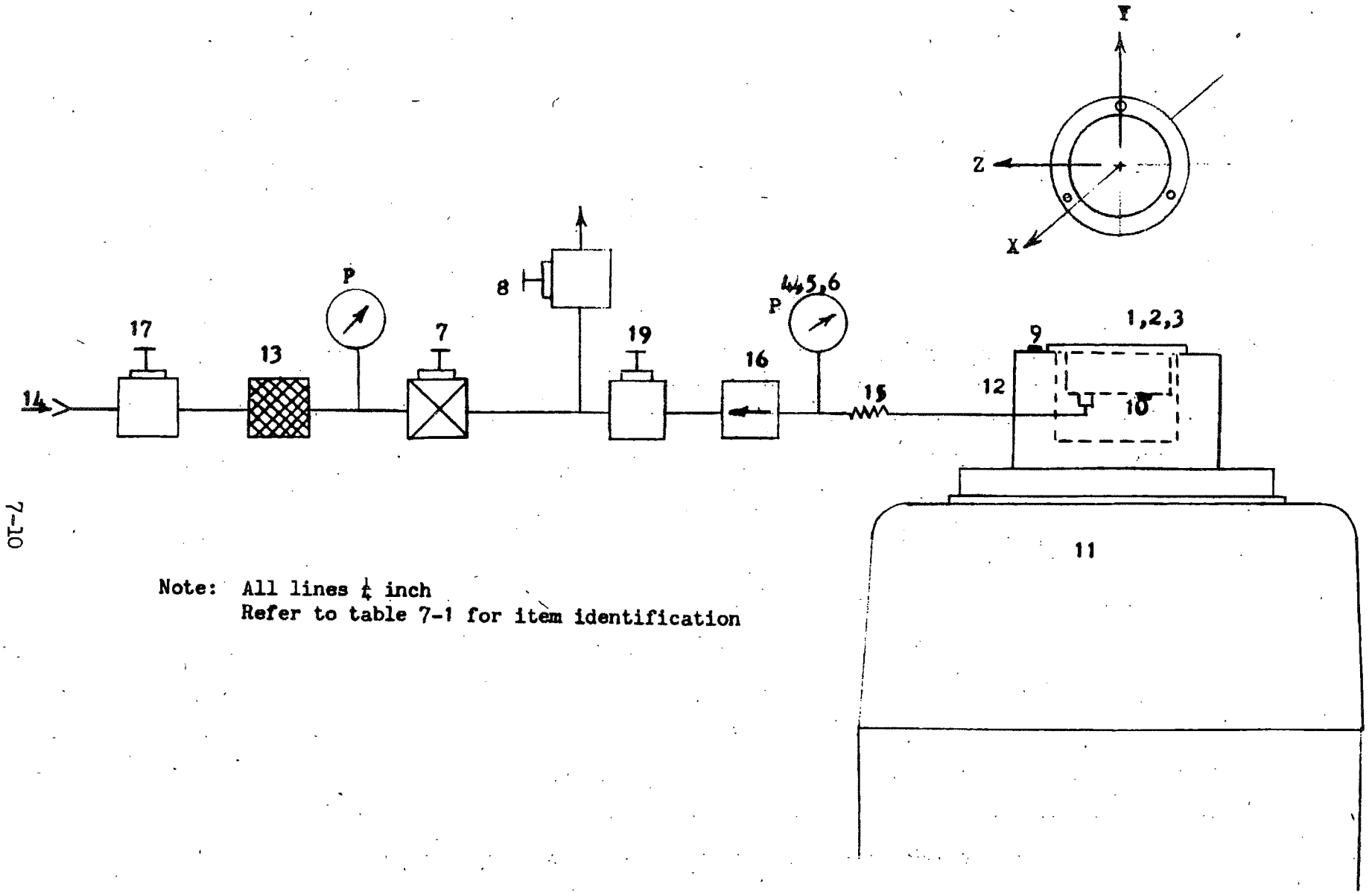
Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings (psig) ±0.5% FS						
	Preceding Vibration Test	Following Sinusoidal Sweep			Following Random Excitation		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
20.0	20.0	20.0	20.0	19.5	20.0	19.5	19.7
40.0	40.3	40.3	39.8	39.8	40.3	39.4	39.9
60.0	59.9	60.1	59.6	59.5	60.0	59.4	59.7
80.0	79.6	79.8	79.0	79.0	79.7	79.0	79.2
100.0	99.5	99.8	99.1	99.1	99.6	99.0	99.3
80.0	79.6	79.8	79.5	79.1	79.7	79.4	79.3
60.0	59.9	60.1	60.0	59.5	60.1	59.5	59.7
40.0	40.3	40.3	40.4	39.8	40.3	40.0	39.9
20.0	20.2	20.1	20.3	19.5	20.0	20.2	19.7

Table 7-6. Vibration Functional Test Data, Specimen 4

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings (psig) ±0.5% FS						
	Preceding Vibration Test	Following Sinusoidal Sweep			Following Random Excitation		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
300	285	300	298	292	300	296	300
600	590	607	601	600	609	600	607
900	890	905	901	900	905	900	905
1200	1188	1193	1197	1192	1193	1190	1200
1500	1483	1489	1485	1488	1491	1479	1490
1200	1190	1200	1198	1198	1199	1195	1200
900	893	907	905	904	904	901	909
600	590	610	605	604	610	603	610
300	289	300	296	298	300	299	300

Table 7-7. Vibration Functional Test Data, Specimen 6

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Readings (psig) ±0.5% FS						
	Preceding Vibration Test	Following Sinusoidal Sweep			Following Random Excitation		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
2000	2020	2050	2010	2050	2060	2010	2050
4000	4010	4050	4025	4060	4100	4020	4050
6000	6020	6025	5995	6010	6040	6000	5995
8000	7950	7995	7950	7995	8000	7950	7975
10000	9990	10000	9975	10000	10000	9995	9975
8000	8010	8050	7995	8010	8060	8010	8050
6000	6075	6125	6075	6100	6150	6100	6125
4000	4100	4175	4100	4115	4200	4125	4150
2000	2075	2125	2075	2100	2150	2100	2110



Note: All lines ¼ inch
Refer to table 7-1 for item identification

Figure 7-1. Vibration Test Schematic and Specimen Axis Orientation

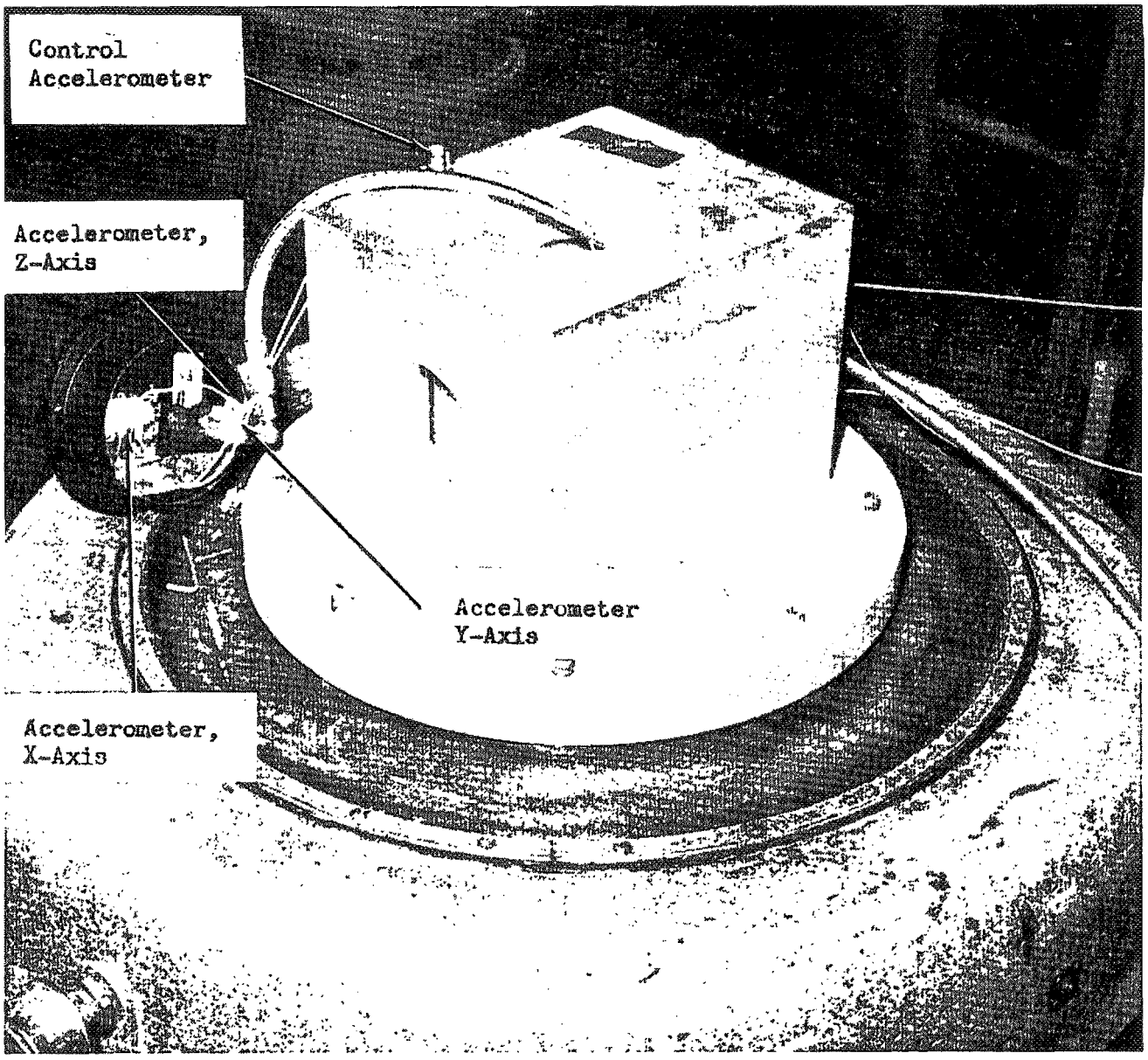


Figure 7-2. Location of Accelerometers During Vibration Testing

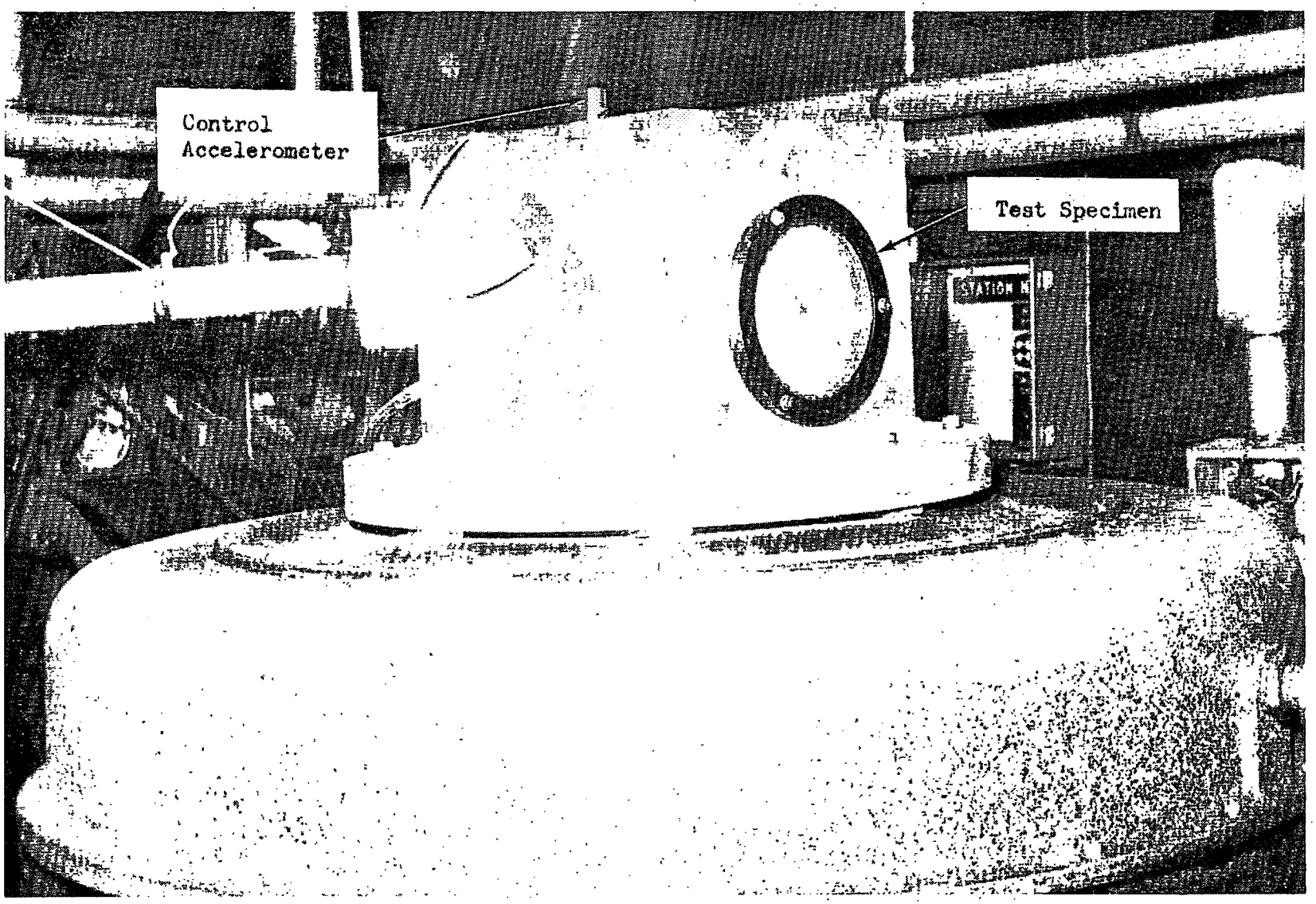


Figure 7-3. Vibration Test Setup

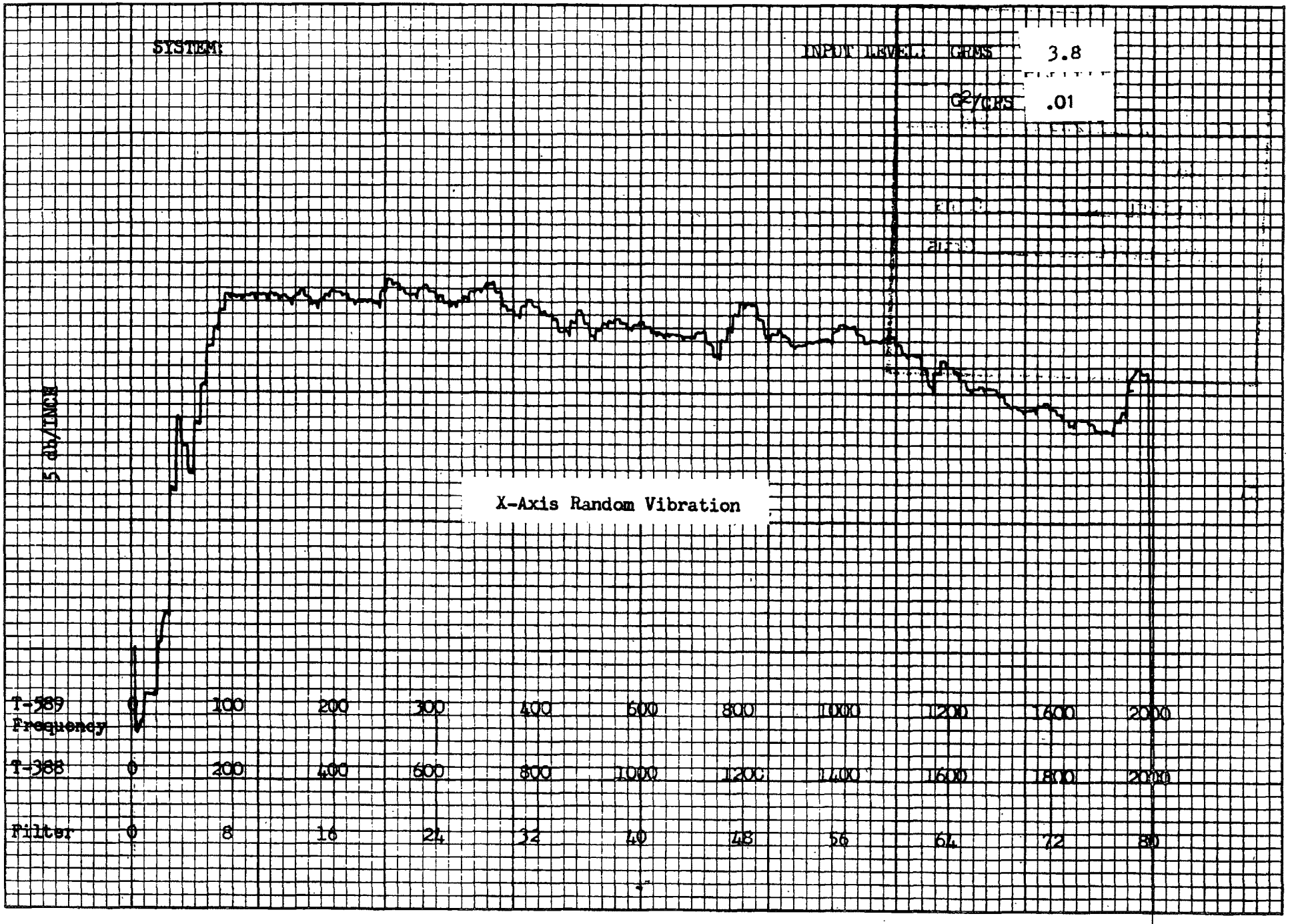


Figure 7-4. Typical Vibration Plot - Control Accelerometer

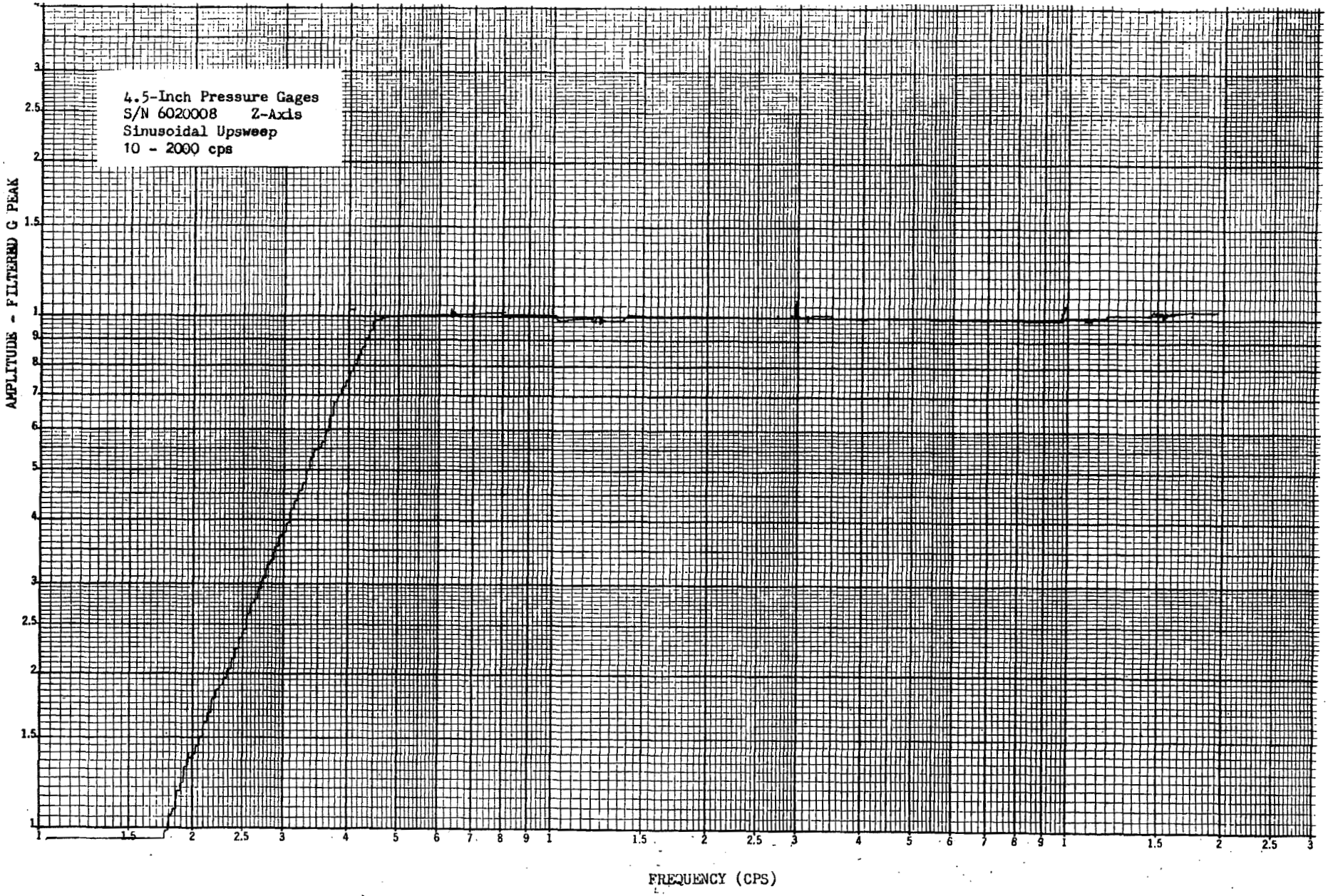


Figure 7-5. Typical Vibration Plot - Control Accelerometer

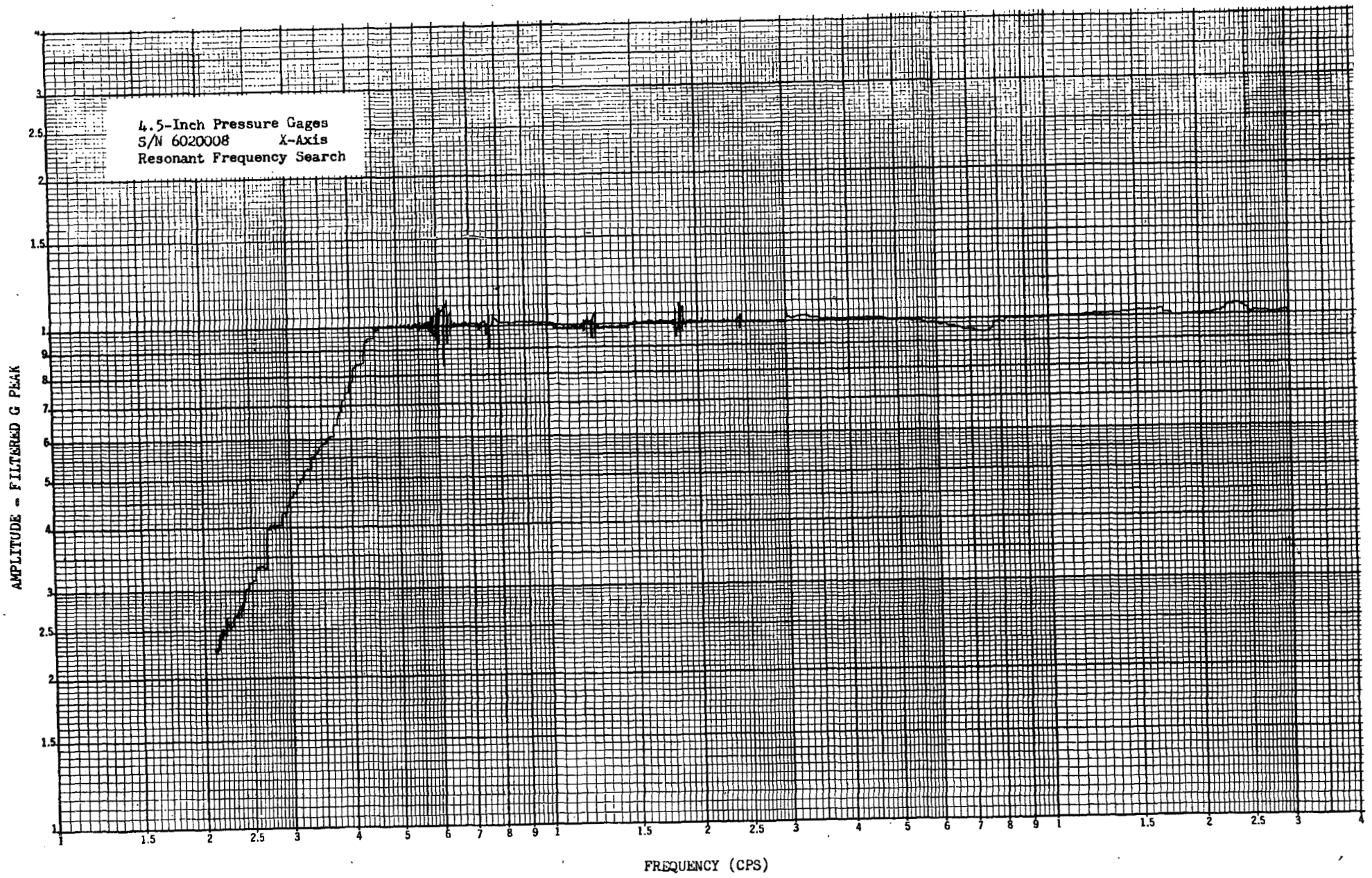


Figure 7-6. Typical Vibration Plot - Control Accelerometer

SECTION VIII

HUMIDITY TEST

8.1 TEST REQUIREMENTS

8.1.1 A humidity test shall be performed on test specimens 1, 3, and 5 to determine the resistance of the pressure gages to the effects of exposure to a warm, humid atmosphere. The test specimens shall be subjected to 10 cycles with a period of 24 hours per cycle.

8.1.2 During the first two hours of each cycle, the temperature and the humidity shall be allowed to stabilize at 165 (+4 , -0)°F and 95 (+5, -0)% humidity.

8.1.3 The test specimens shall then be exposed to 6 hours of a constant humidity of 95 (+5, -0) percent.

8.1.4 During the last 16 hours of each cycle, the temperature shall be gradually brought back to the initial temperature as shown in figure 8-1.

8.1.5 At the completion of 10 cycles, the test specimens shall be visually inspected and functionally tested.

8.2 TEST PROCEDURE

8.2.1 With their ports capped, specimens 1, 3, and 5 were placed in a chamber, which met the requirements described in KSC-STD-164(D). The test setup is shown in figure 8-1.

8.2.2 The chamber was adjusted to stabilize at 165 (+4, -0)°F and 95 (+5, -0) percent humidity within a 2 hour period. The test specimens were exposed to this constant temperature for a period of 6 hours. Then, over a period of 16 hours, the chamber temperature was gradually returned to the initial temperature.

8.2.3 Procedure 8.2.2 was repeated 9 times for a total of 10 complete cycles as specified in figure 8-2.

8.2.4 The pressure gages were removed from the chamber and returned to room ambient conditions. Excessive moisture on the external surface of the specimens was removed by wiping.

8.2.5 Within 1 hour following the completion of this test, a visual inspection and a functional test were performed as applicable for each test specimen.

8.2.6 All data were recorded.

8.3 TEST RESULTS

8.3.1 Specimens 1, 3, and 5 indicated significant changes in pressure readings taken during functional tests performed prior to the humidity test and following the humidity test.

8.3.2 The shifts in readings observed during the functional tests could be the result of the environment or a demonstration of non-repeatability of the gages.

8.4 TEST DATA

8.4.1 Data from the functional tests performed on specimen 2, 4, and 6 are presented in table 8-1.

Table 8-1. Humidity Functional Test Data

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Reading (psig) ±0.5% FS			
	Specimen	S/N	Preceding Humidity Test	Following Humidity Test
20.0	1	60C20001	20.4	20.7
40.0			40.4	41.0
60.0			60.5	60.8
80.0			80.6	80.6
100.0			100.0	100.0
80.0			80.6	80.7
60.0			60.6	60.7
40.0			40.5	41.0
20.0			20.5	20.7
300	3	60C20005	297	301
600			598	607
900			899	912
1200			1195	1203
1500			1495	1500 *
1200			1197	1206
900			902	912
600			600	609
300			297	307
2000	5	60C20007	1970	1940
4000			4000	3940
6000			6030	5930
8000			8020	7915
10000			—	9920
8000			8100	8000
6000			6110	6010
4000			4060	3960
2000			2040	1920

* Standard gage indicated 1492

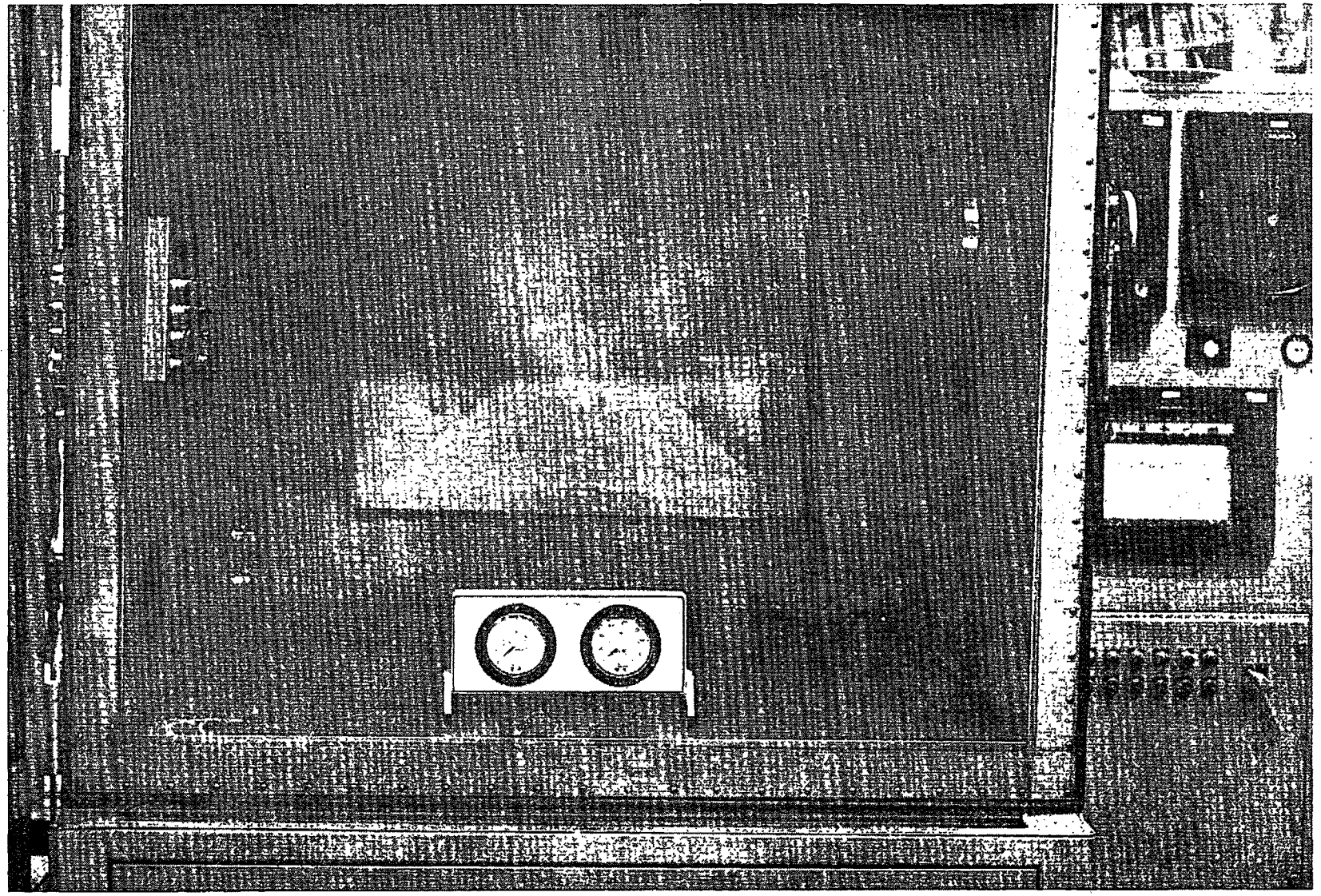


Figure 8-1. Humidty Test Setup

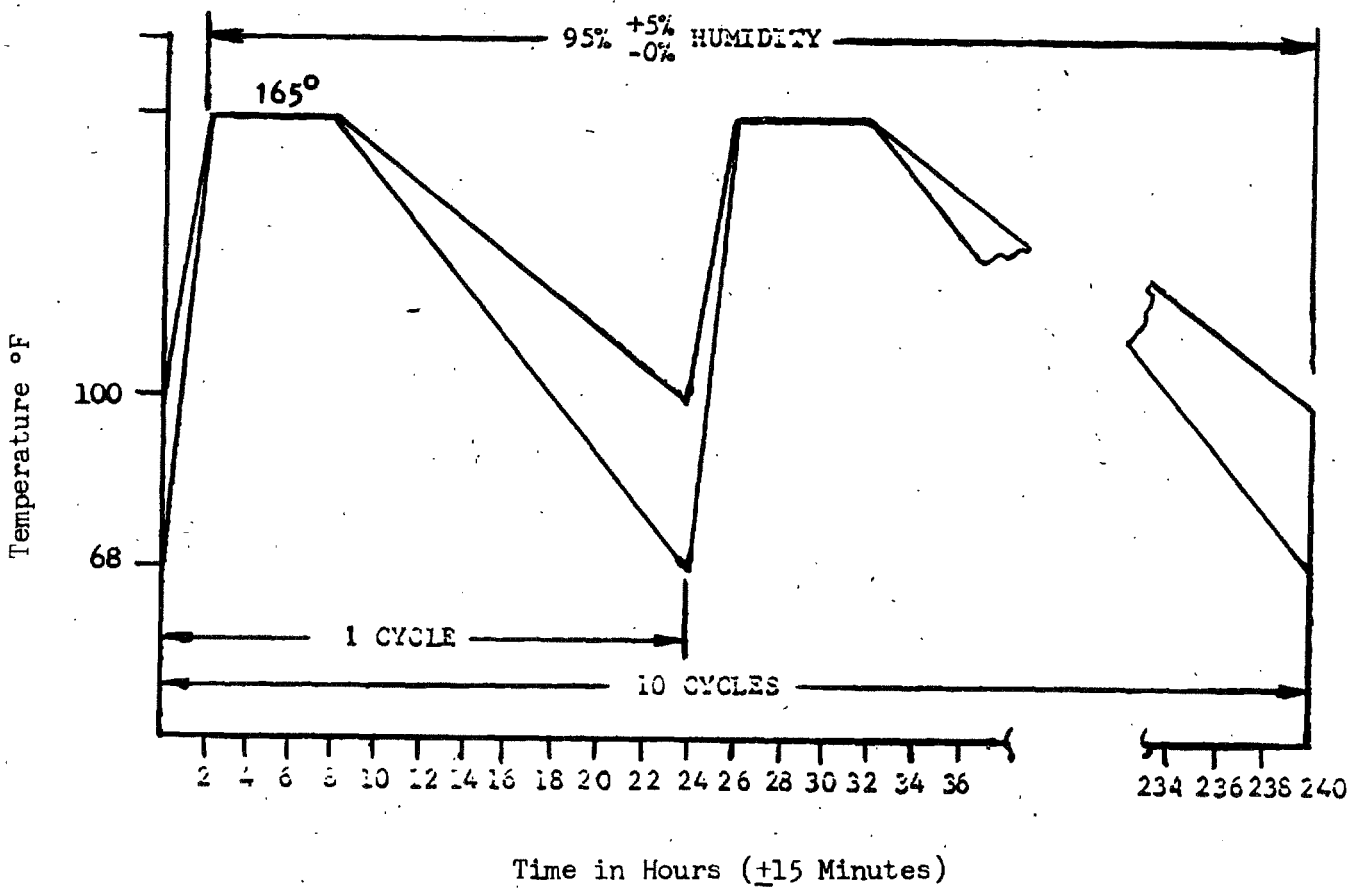


Figure 8-2. Humidity Cycling

SECTION IX

SAND AND DUST TEST

9.1 TEST REQUIREMENTS

9.1.1 A sand and dust test shall be performed on test specimens 1, 3, and 5 to determine the resistance of the pressure gages to the abrasive and corrosive characteristics of blown fine sand and dust.

9.1.2 The test specimens shall be subjected to 2 hours of exposure to fine sand and dust with a velocity of 100 to 500 ft/min. and a temperature of 77°F.

9.1.3 At the end of this 2 hour period the temperature shall be increased to 160°F. This temperature shall be maintained for two additional hours.

9.1.4 Following the preceding exposure time, the gages shall be allowed to cool to room temperature and shall be functionally tested and inspected.

9.2 TEST PROCEDURE

9.2.1 This test was subcontracted to the Associated Testing Laboratory, Inc. of Wayne, New Jersey. The following was taken from Associated Testing Laboratory, Inc. report No. L1014-7512:

> "The Sand and Dust Test was conducted in accordance with Section 16 of Specification KSC-STD-164(D).
>
> The Gauges were placed in a Sand and Dust Test Chamber. The chamber temperature was increased to and maintained at + 77°F for a period of two hours. At the completion of this two-hour period, the chamber temperature was increased to and maintained at + 160°F for an additional two-hour period. The chamber temperature was then returned to room ambient temperature.
>
> Throughout the entire Sand and Dust Test, the sand and dust density within the chamber was maintained between 0.1 and 0.5 gram per cubic foot and the sand and dust velocity was maintained between 100 and 500 feet per minute. The sand and dust used in the test was of an angular structure having the characteristics described in Specification KSC-STD-164(D).
>
> At the completion of the Sand and Dust Test, the Gauges were removed from the chamber and allowed to cool to room ambient temperature. The accumulated dust was removed from the Gauges by wiping and the Gauges were then visually examined for evidence of deterioration."

9.2.2 Figure 9-1 shows the test specimen in the sand and dust chamber.

9.3 TEST RESULTS

9.3.1 The following test results were taken from Associated Testing Laboratory, Inc. report No. L1014-7512:

> "Visual examination of the Gauges at the completion of the Sand and Dust Test revealed no evidence of deterioration."

9.3.2 Results from functional tests performed upon return of the test specimen from Associated Testing Laboratory indicated a change in pressure readings as compared to the results of functional tests performed prior to the sand and dust test. A contributing factor to the shift in readings could have been the handling of the test specimen during shipment between this laboratory and the one performing the sand and dust test.

9.4 TEST DATA

9.4.1 Data recorded during functional tests performed on specimens 1, 3, and 5 are presented in table 9-2.

Table 9-1. Sand and Dust Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956D		0-to 100-psig ±.5% FS
2	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956T		0-to 1500-psig ±.5% FS
3	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956T		0-to 10,000-psig ±.5% FS
4	Test Chamber, Sand and Dust	Associated Testing Laboratory, Inc.	SD-36 -LC	NA	Cal. date: 9/8/66

Table 9-2. Sand and Dust Functional Test Data

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Reading (psig) ±0.5% FS			
	Specimen	S/N	Preceding Sand & Dust	Following Sand & Dust
20.0	1	6020001	19.2	20.3
40.0			39.0	40.1
60.0			58.9	60.0
80.0			79.0	80.0
100.0			99.0	100.0
80.0			79.5	80.4
60.0			59.3	60.7
40.0			39.6	40.1
20.0			19.5	20.3
300	3	6020005	297	304
600			603	605
900			405	908
1200			1201	1204
1500			1500	1500
1200			1209	1207
900			907	912
600			607	611
300			299	308
2000	5	6020007	2040	2010
4000			4080	4040
6000			6075	6060
8000			8075	8050
10000			10000 *	10000 **
8000			8125	8100
6000			6160	6130
4000			4120	4100
2000			2060	2040

* Standard gage indicated 9975 psig.
** Standard gage indicated 9970 psig.

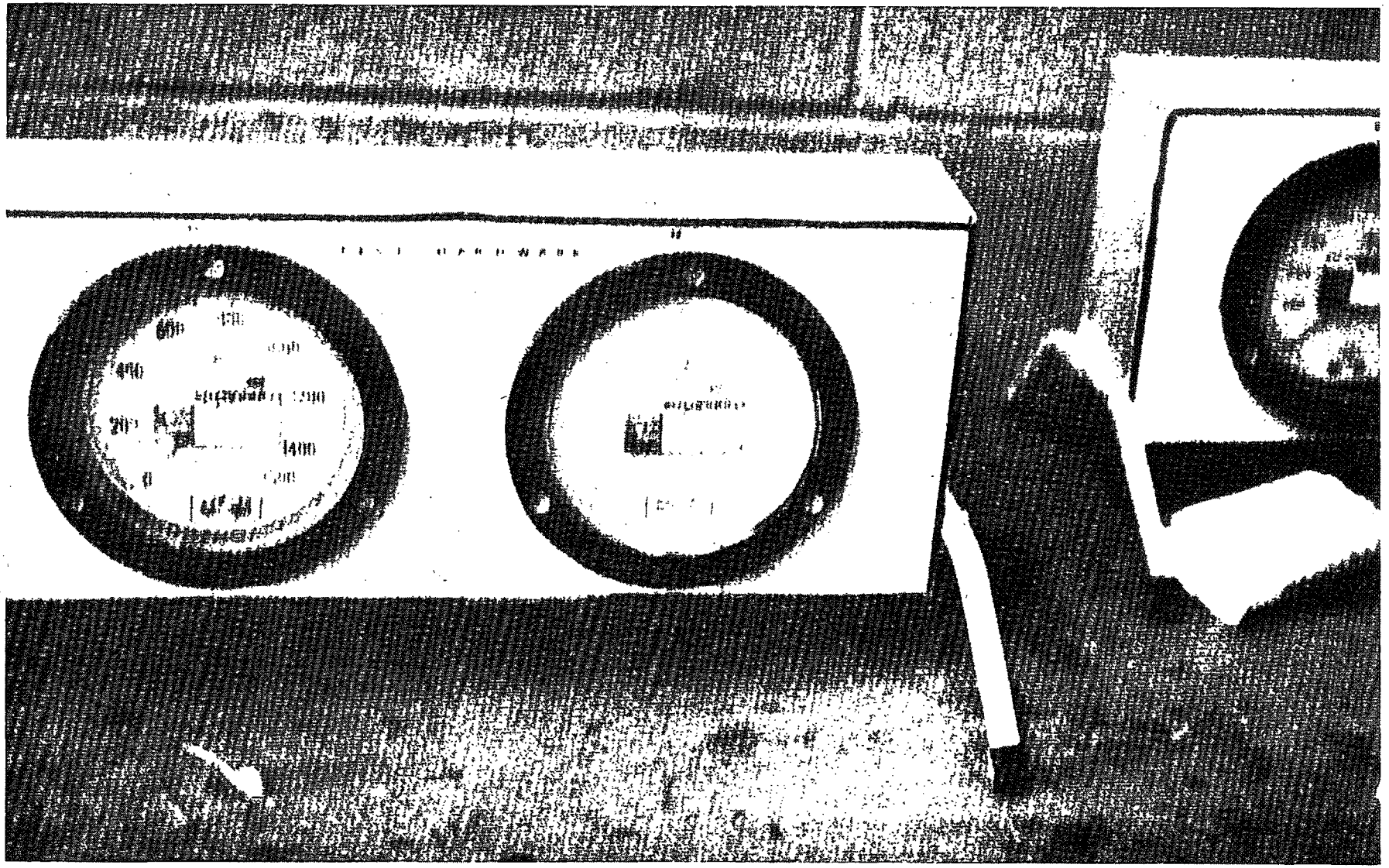


Figure 9-1. Sand and Dust Test Setup

SECTION X

SALT FOG TEST

10.1 TEST REQUIREMENTS

10.1.1 Test specimens 1, 3, and 5 shall be subjected to a salt fog test. The test specimens shall be placed in a test chamber with all the additional equipment described in KSC-STD-164(D). For a period of 240 (±2) hours the pressure gages shall be subjected to an atomized salt solution.

10.1.2 The solution shall contain 5 parts by weight of salt in 95 parts by weight of water with no more than 200 parts per million of total solids. The specific gravity of the salt solution shall be from 1.023 to 1.037 with a reference temperature of 95 (+2, -4)°F. The salt solution shall also have a pH value of 6.5 to 7.2. Diluted chemically pure hydrochloric acid or C.P. sodium hydroxide may be used to adjust the value of the pH.

10.1.3 Measurements of the characteristics of the salt solution shall be made according to KSC-STD-164(D).

10.1.4 Following the prolonged exposure of 240 hours, the test specimens shall be subjected to a functional test within one hour after returning to room ambient conditions.

10.2. TEST PROCEDURE

10.2.1 Specimens 1, 3, and 5 were inspected for dirt, corrosion and oily films.

10.2.2 With their ports capped the specimens were placed in the test chamber as shown in figure 10-1 using the equipment listed in table 10-1.

10.2.3 The chamber was adjusted so that the temperature was 95 (+4, -2)°F and so that the clean fog-collecting receptacle in the exposure zone would collect from 0.5 to 3.0 milliliters of solution per hour for each 80 square centimeters of horizontal collecting area.

10.2.4 The conditions set forth were maintained for 240 (±2) hours.

10.2.5 At the end of the 240-hour period, the specimens were removed from the chamber and allowed to return to room ambient conditions.

10.2.6 Salt deposits were removed as necessary to make all mechanical connections.

10.2.7 Within one hour after returning to room ambient conditions, a functional test was performed on each specimen as applicable in Section IV.

10.2.8 Salt deposits were removed from the external surface of the specimens.

10.2.9 All data were recorded.

10.3 TEST RESULTS

10.3.1 During functional tests performed following the salt fog test, test specimens 1, 3, and 5 indicated a significant change in pressure readings as compared to the readings taken during the functional test performed prior to the salt fog test.

10.3.2 The gage back plates were removed for examination purposes. The inside of the specimens were found to be contaminated with salt deposits and sand and dust from the previous test (see figure 10-2). There was evidence of corrosion.

10.3.3 Contaminants were removed without disturbing the gage mechanisms.

10.3.4 The back plates were replaced and testing was continued.

10.4 TEST DATA

Data taken during functional tests performed prior to and following the salt fog test for specimens 1, 3, and 5 are presented in table 10-2.

Table 10-1. Salt Fog Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Helicoid Gage Division American Chain and Cable Co.	3956D	6020001	0-to 100-psig
			3956M	6020005	0-to 1500-psig
			3956T	6020007	0-to 10,000-psig
2	Salt Fog Chamber	Industrial Filter & Pump Mfg. Co.	411.1C	5-3632	As Specification KSC-STD-164(D)

Table 10-2. Salt Fog Functional Test Data

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Reading (psig) ±0.5% FS			
	Specimen	S/N	Preceding Salt Fog Test	Following Salt Fog Test
20.0	1	6020001	20.3	19.4
40.0			40.1	39.3
60.0			60.0	59.0
80.0			80.0	79.1
100.0			100.0	98.4
80.0			80.4	79.2
60.0			60.7	59.2
40.0			40.1	39.0
20.0			20.3	19.0
300	3	6020005	304	295
600			605	593
900			908	902
1200			1204	1200
1500			1500	1500
1200			1207	1205
900			912	908
600			611	600
300			308	295
2000	5	6020007	2010	1950
4000			4040	3950
6000			6000	5950
8000			8050	7960
10000			10000 *	9910
8000			8100	8006
6000			6130	6030
4000			4100	4020
2000			2040	2000

* Standard gage indicated 9970

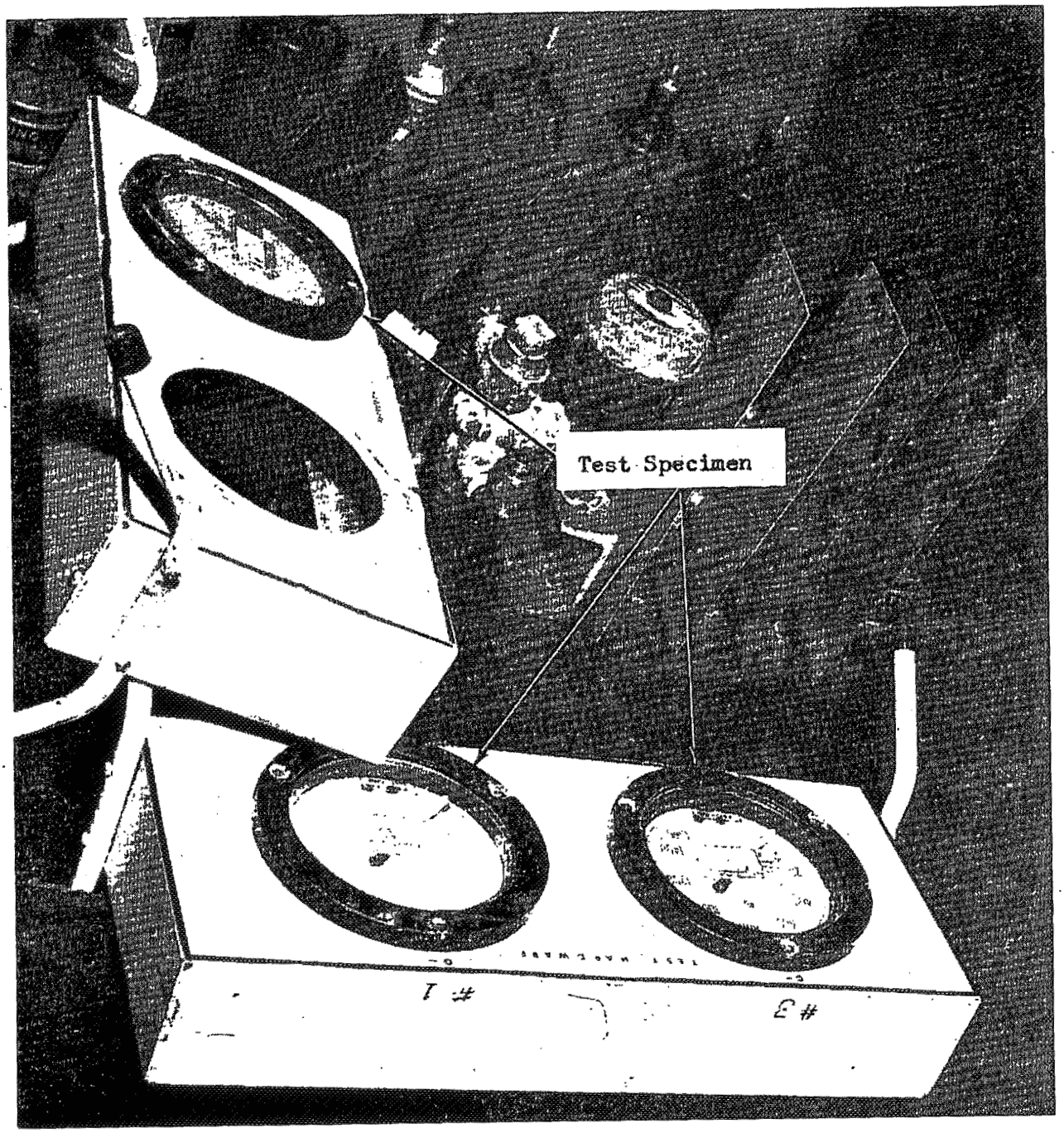


Figure 10-1. Salt Fog Test Setup

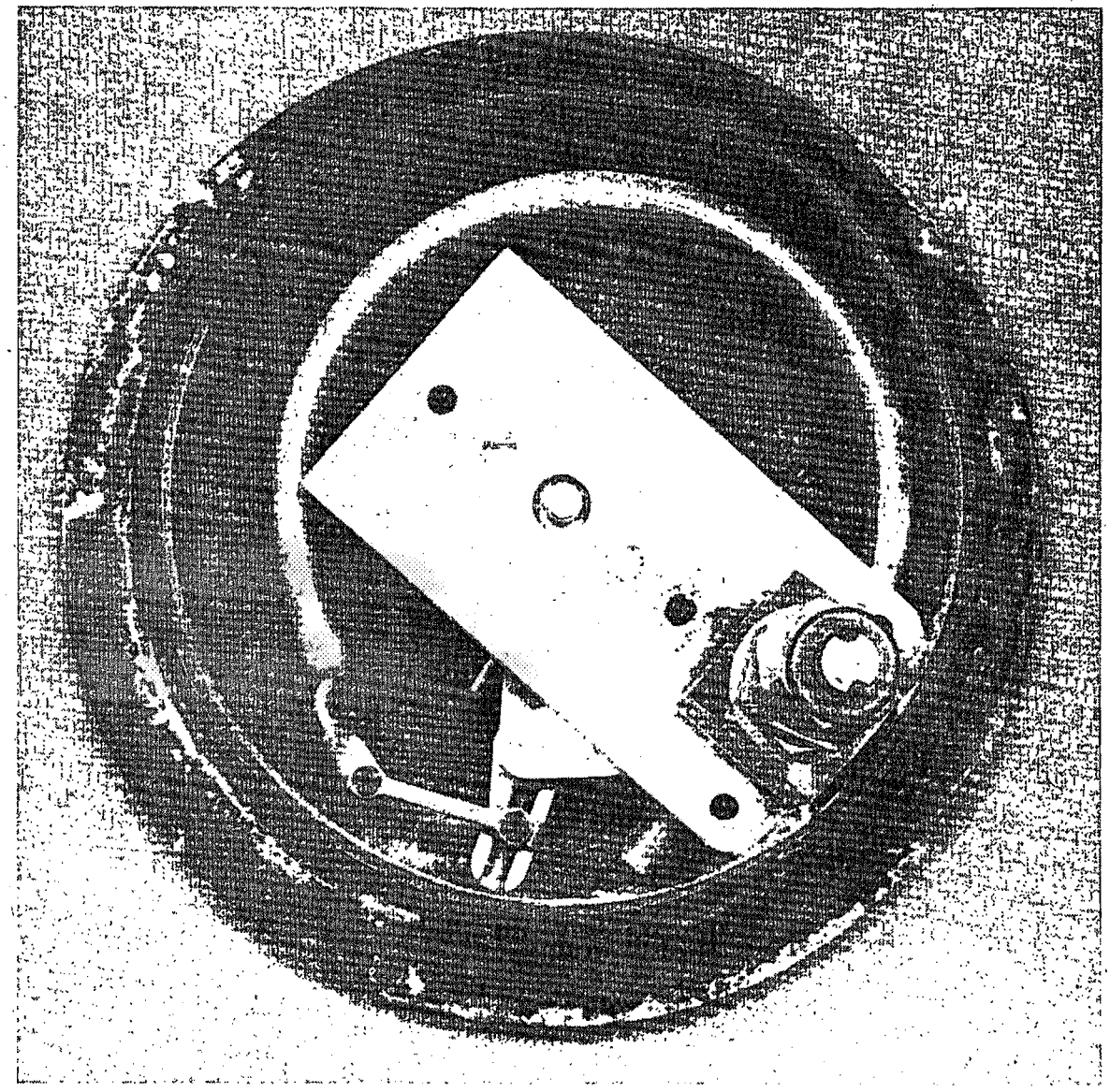


Figure 10-2. Typical View of Salt Deposits Inside the Specimen

SECTION XI

SURGE TEST

11.1 TEST REQUIREMENTS

11.1.1 Test specimen 1 shall be subjected to 100 pressure surges. Each pressure surge shall range from zero psig to 100 psig within 100 milliseconds.

11.1.2 Test specimen 3 shall be subjected to 100 pressure surges. Each pressure surge shall range from zero to 1500 psig within 100 milliseconds.

11.1.3 Test specimen 5 shall be subjected to 100 pressure surges. Each pressure surge shall range from zero to 10,000 psig within 100 milliseconds.

11.2 TEST PROCEDURE

11.2.1 A functional test was performed on specimens 1, 3, and 5 as more than 72 hours had elapsed since the previous functional test.

11.2.2 The test setup was assembled as shown in figure 11-1 and 11-2 using the equipment listed in table 11-1.

11.2.3 Specimen 1 (item 1) and gage 4 were installed in the test setup.

11.2.4 All hand valves were closed and all regulators were adjusted for zero outlet pressure.

11.2.5 Hand valve 8 was opened and the supply pressure was monitored on gage 16.

11.2.6 Regulator 7 was adjusted until an outlet pressure of 100 psig was indicated on gage 4. Hand valve 9 was opened.

11.2.7 Timer 12 was adjusted to cycle solenoid valve and regulator 7 was adjusted until the specimen was pressurized from zero to 100 psig within 100 milliseconds.

11.2.8 Surge history was recorded on oscillograph 14 using transducer 10.

11.2.9 A total of 100 surge cycles were performed.

11.2.10 Specimen 1 and gage 4 were replaced by specimen 3 (item 2) and gage 5 in the test setup. Hand valve 9 was opened.

11.2.11 Timer 12 was adjusted to cycle solenoid valve 11 and regulator 7 was adjusted until the specimen was pressurized from zero to 1500 psig within 100 milliseconds.

11.2.12 Surge history was recorded on oscillograph 14 using transducer 10.

11.2.13 A total of 100 surge cycles were performed.

11.2.14 Test specimen 3 and gage 5 were replaced by test specimen 5 (item 3) and gage 6 in the test setup. Gage saver 17 was removed from the test setup. Hand valve 9 was opened.

11.2.15 Timer 12 was adjusted to cycle solenoid valve 11, and regulator 7 was adjusted until the specimen was pressurized from zero to 10,000 psig in 100 milliseconds.

11.2.16 Surge history was recorded on oscillograph 14 using transducer 10.

11.2.17 A total of 100 surge cycles were performed.

11.2.18 Upon completion of the surge test, specimens 1, 3, and 5 were subjected to a functional test.

11.3 TEST RESULTS

11.3.1 Specimens 1 and 3 were not significantly affected by the 100 surge cycles. Test specimen 5, however, indicated a marked change in pressure readings taken during the functional test performed following the surge test as compared to pressure readings taken during the functional test performed prior to the surge test.

11.4 TEST DATA

11.4.1 Functional test data for specimens 1, 3, and 5 are presented in table 11-2. Typical surge wave forms are shown in figures 11-3 through 11-4.

Table 11-1. Surge Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956D	6020001 6020003	0-to 100-psig ± 0.5% FS
2	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956M	6020005 6020006	0-to 1500-psig ± 0.5% FS
3	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956T	6020007 6020008	0-to 10,000-psig ± 0.5% FS
4	Gage, Pressure (Calibrated)	Heise	NA	NASA 014226	0-to 100-psig ± 0.1% FS Cal. date: 9/28/66
5	Gage, Pressure (Calibrated)	Heise	NA	NASA 95-1569 -B	0-to 1500-psig ± 0.1% FS Cal. date: 10/13/66
6	Gage, Pressure (Calibrated)	Heise	NA	NASA 014231	0-to 10,000-psig ± 0.1% FS Cal. date: 10/13/66
7	Regulator, Hand Loaded	Tescom	26-1021 -24	8360	Outlet Pressure 0-to 10,000-psig
8	Hand Valve	Diagan	AN-4	NA	1½-Inch
9	Valve, Hand (Variable Orifice)	Robbins Aviation, Inc.	SSKG-250 -4T	NA	¼-Inch
10	Transducer, Pressure	Taber Instrument Corp.	176	NASA 08-113 95-1423 -B	3 required 0-to 150-psig 0-to 2000-psig 0-to 10,000-psig all ± 0.4% FS Cal date: 1/6/67
11	Valve, Solenoid	Marotta	NA	NA	3-way, ¼-Inch

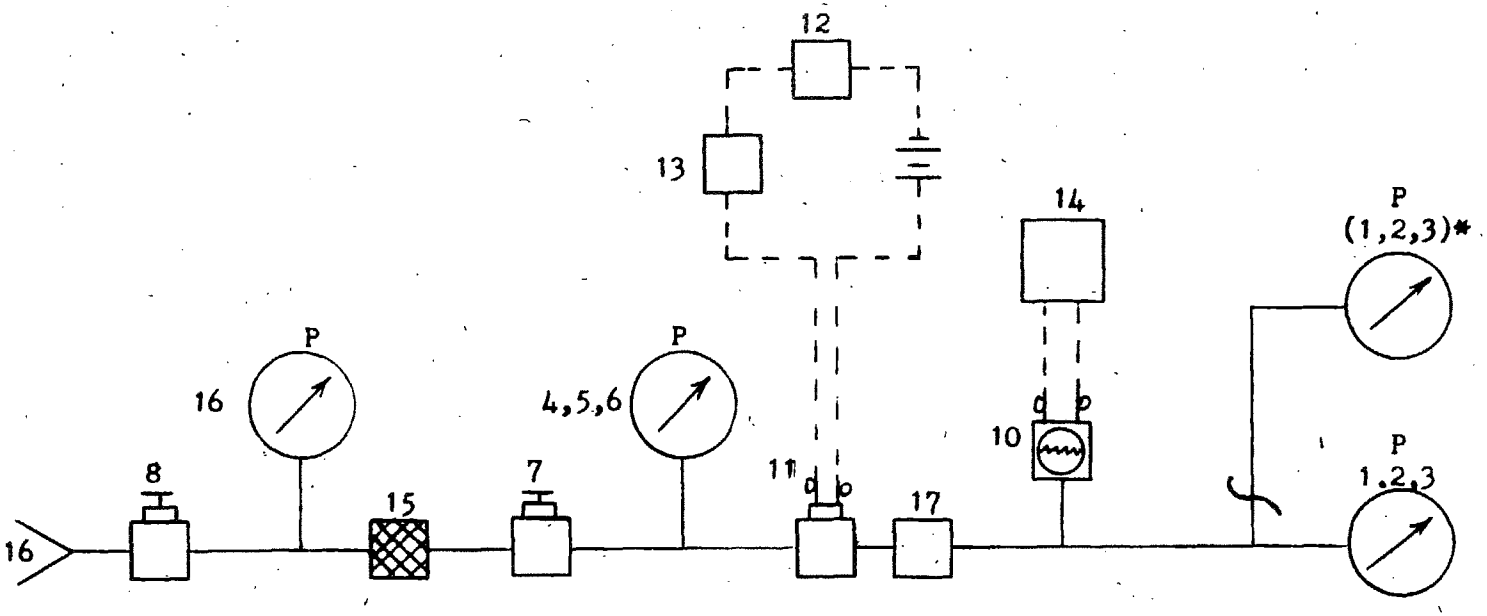
Table 11-1. Surge Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
12	Timer	G. C. Wilson Co.	NA	NASA 106-1026 B	Cal. date: 4/20/64
13	Counter	C. G. Wilson Co.	NA	NA	5-digit
14	Oscillograph	Consolidated Electro Dynamics Corp.	NA	NASA 012587	Cal. date: 7/29/66
15	Filter				2-micron
16	GN_2 Pressure Source	CCSD	NA	NA	3000-psig for items 1 and 2 10,000-psig for item 3
17	Gage Saver	Republic Mfg. Co.	680-3D2 680-1D2	NA NA	1000-to 5000-psig for item 3 15-to 250-psig for item 1

Table 11-2. Surge Functional Test Data

Standard Gage Reading (psig) ±0.1% FS	Specimen Gage Reading (psig) ±0.5% FS			
	Specimen	S/N	Preceding Surge Test	Following Surge Test
20.0	1	6020001	20.3	20.0
40.0			40.3	40.1
60.0			60.3	60.1
80.0			80.5	80.2
100.0			100.0	100.0
80.0			80.5	80.0
60.0			60.3	59.9
40.0			40.3	39.9
20.0			20.2	19.8
300	3	6020005	301	304
600			604	605
900			906	910
1200			1206	1210
1500			1500	1500
1200			1210	1211
900			911	912
600			609	609
300			302	304
2000	5	6020007	1990	2170
4000			4020	4165
6000			6030	6225
8000			8000	8210
10000			9980	10000 *
8000			8050	8250
6000			6020	6275
4000			4065	4240
2000			2020	2160

* Standard gage indicated 9775 psig.



Note: All lines ¼ inch.
Refer to table 11-1 for item identification.
*Two specimens tested together for cycle test only.

Figure 11-1. Surge Test Schematic

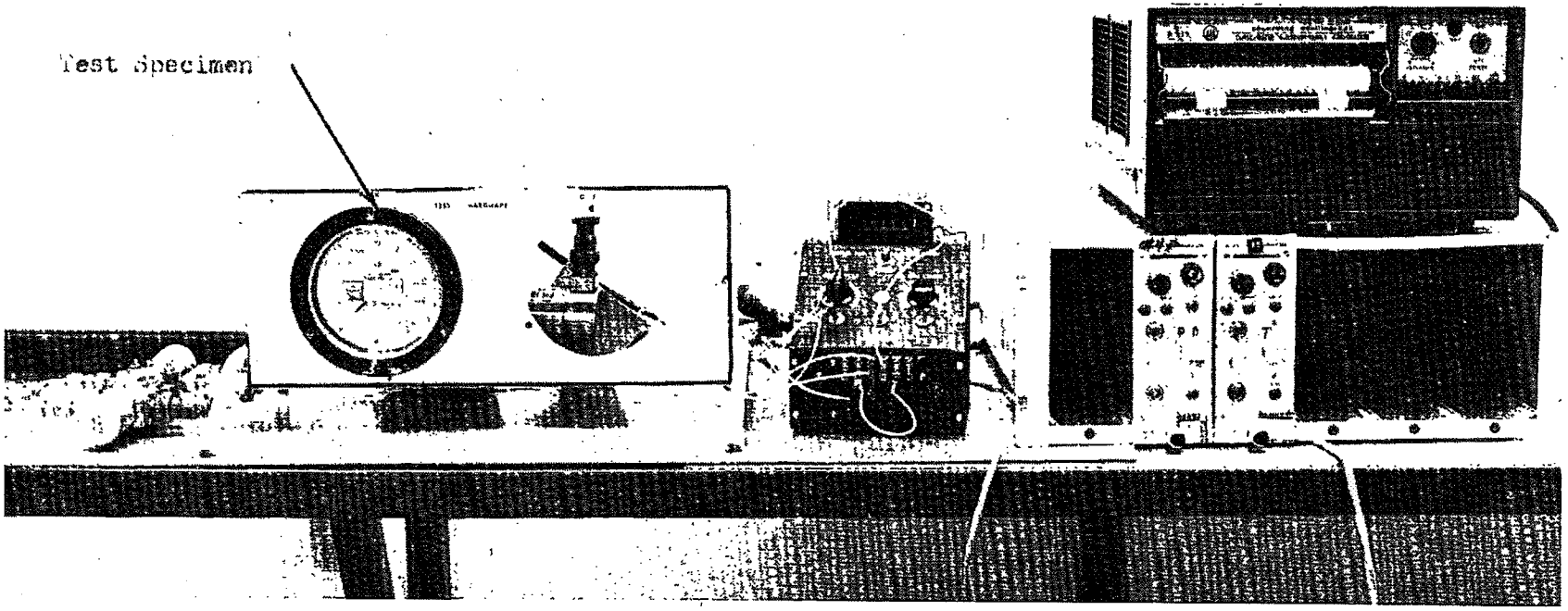


Figure 11-2. Surge Test Setup

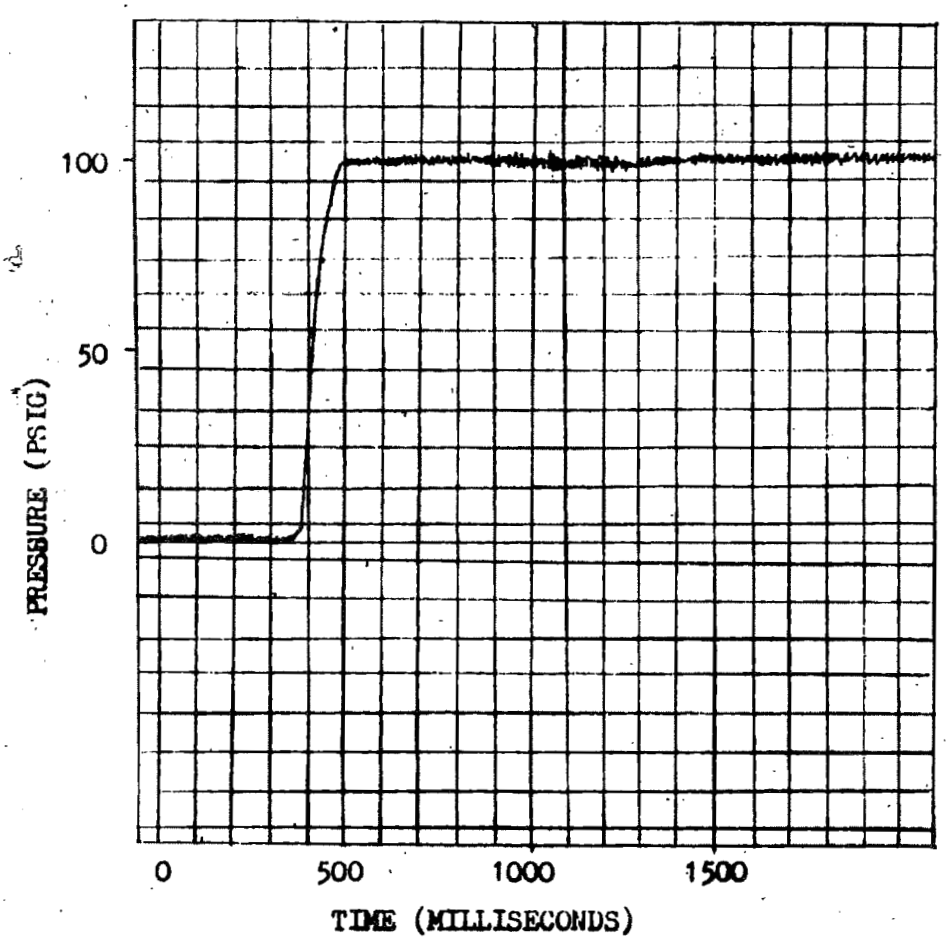


Figure 11-3. Typical Pressure Surge Cycle, Specimen 1

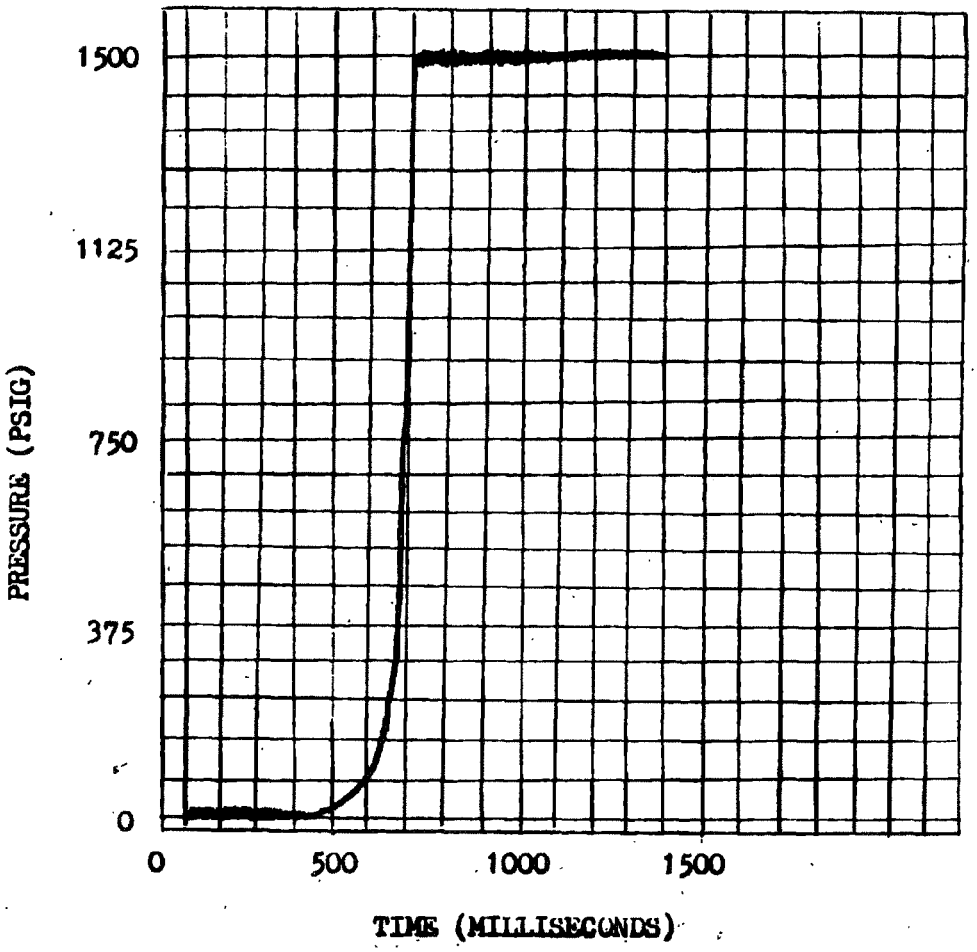


Figure 11-4. Typical Pressure Surge Cycle, Specimen 3

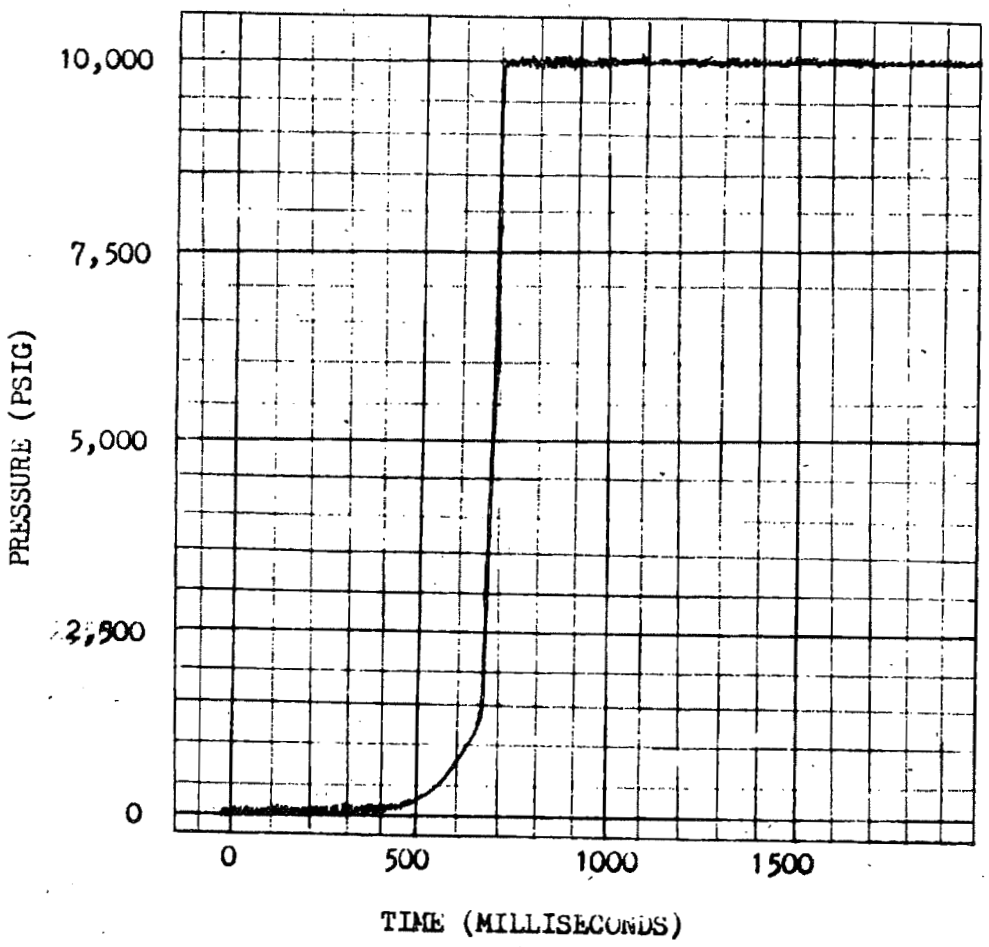


Figure 11-5. Typical Pressure Surge Cycle, Specimen 5

SECTION XII

LIFE CYCLE TEST

12.1 TEST REQUIREMENTS

12.1.1 A life cycle test shall be performed on test specimens 1, 2, 3, 4, 5, and 6.

12.1.2 The test specimens shall be pressurized from zero psig to 80 per cent of full scale within 5 seconds. Forty thousand such cycles shall be performed on each specimen.

12.1.3 A functional test shall be performed after 100 cycles, 500 cycles, 1000 cycles, and every 5000 cycles thereafter.

12.2 TEST PROCEDURE

12.2.1 Specimens 1, 2, 3, and 4 were calibrated by CCSD Metrology Laboratory prior to the beginning of the life cycle test in increasing pressure readings only against a dead weight tester. Several attempts were made by CCSD Metrology Laboratory to calibrate specimens 5 and 6 in increasing and decreasing pressure readings against a dead weight tester. Functional tests were performed on test specimens 1 through 6 as more than 72 hours had elapsed since the previous functional test.

12.2.2 The test setup was assembled as shown in figures 11-1 and 12-1 using the equipment listed in table 11-1.

12.2.3 Test specimens 1 and 2 (item 1) and gage 4 were installed in the test setup.

12.2.4 All hand valves were closed and all regulators were adjusted for zero outlet pressure.

12.2.5 Hand valve 8 was opened and the supply pressure was indicated on gage 16.

12.2.6 Regulator 7 was adjusted until an outlet pressure of 80 psig was indicated on gage 4.

12.2.7 Timer 12 was adjusted to cycle solenoid valve 11 at approximately 5 cycles per minute. Regulator 7 and hand valve 9 were adjusted until the specimen was pressurized from zero to 80 psig in 5 seconds.

12.2.8 A functional test was performed after 100, 500, 1000, 6000, 11,000, 15,000, 20,000, 25,000, 30,000, 35,000, and 40,000 cycles.

12.2.9 All data were recorded.

12.2.10 Specimens 1 and 2 and gage 4 were removed and were replaced by specimens 3 and 4 (item 2) and gage 5 in the test setup.

12.2.11 Timer 12 was adjusted to cycle solenoid valve 11 at approximately 5 cycles per minute. Regulator 7 and hand valve 9 were adjusted until the specimen was pressurized from zero to 1200 psig in 5 seconds.

12.2.12 A functional test was performed after 100, 500, 1,000, 5,000, 10,000, 15,000, 20,000, 25,000, 30,000, 35,000, and 40,000 cycles.

12.2.13 All data were recorded.

12.2.14 Specimens 3 and 4 and gage 5 were removed and were replaced by test specimens 5 and 6 (item 3) and gage 6 in the test setup.

12.2.15 Timer 12 was adjusted to cycle solenoid valve 11 at approximately 5 cycles per minute. Regulator 7 and hand valve 9 were adjusted until the specimen was pressurized from zero to 8,000 psig in 5 seconds.

12.2.16 A functional test was performed after 100, 500, 1,000, 5,000, 10,000, 15,000, 20,000, 25,000, 30,000, 35,000, and 40,000 cycles.

12.3 TEST RESULTS

12.3.1 The functional test performed after 40,000 life cycles indicated that specimens 1 and 2 were then slightly out of calibration.

12.3.2 After 100 life cycles, specimens 3 and 4 were out of calibration.

12.3.3 All attempts to calibrate specimens 5 and 6 failed and the specimens were rejected by the CCSD Metrology Laboratory as being non-repeatable. These specimens were out of calibration early in the life cycle test, but testing was continued so that performance deterioration could be observed.

12.4 TEST DATA

Data recorded during functional tests are presented in table 12-1.

Table 12-1. Life Cycle Functional Test Data (Sheet 1 of 3)

Standard Gage Reading (psig) ±0.1% FS	Preceding Life Cycle Test	Cycles Completed										
		100	500	1000	6000	11,000	15,000	20,000	25,000	30,000	35,000	40,000
	Specimen 1 Gage Reading (psig, ±0.5% FS) S/N 6020001											
20.0	20.0	20.0	20.1	20.3	20.3	20.3	20.3	20.3	20.1	20.4	20.3	20.8
40.0	40.0	40.0	39.8	40.2	40.3	40.2	40.3	40.3	40.4	40.4	40.1	40.7
60.0	59.8	60.0	60.1	60.3	60.3	60.0	60.3	60.3	60.3	60.3	60.2	60.5
80.0	80.1	80.3	80.2	80.4	80.3	80.0	79.9	80.2	80.3	80.1	80.0	80.6
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	100.0	100.0	100.0(1)
80.0	80.0	80.3	80.3	80.3	80.3	80.0	80.3	80.3	80.2	80.1	80.1	80.5
60.0	60.0	60.0	60.0	60.2	60.3	60.1	60.3	60.3	60.2	60.2	60.1	60.5
40.0	40.0	40.0	40.0	40.2	40.3	40.2	40.5	40.4	40.4	40.4	40.5	40.7
20.0	20.0	20.0	20.1	20.1	20.3	20.3	20.5	20.4	20.3	20.3	20.5	20.6
	Specimen 2 Gage Reading (psig, ±0.5% FS) S/N 6020003											
20.0	20.6	20.5	20.5	20.6	20.6	20.4	20.3	20.3	20.1	20.6	20.3	20.9
40.0	40.6	40.6	40.2	40.7	40.7	40.3	40.3	40.6	40.5	40.6	40.4	40.8
60.0	60.4	60.4	60.4	60.4	60.5	60.3	60.4	60.4	60.4	60.3	60.4	60.7
80.0	79.8	79.8	79.8	79.9	79.9	79.7	79.6	79.9	80.0	79.9	79.9	80.3
100.0	99.7	99.8	99.8	99.5	99.8	99.7	99.6	99.7	99.8	99.6	99.7	100.0
80.0	79.6	79.8	79.8	79.9	79.9	79.7	79.9	80.0	80.0	79.8	79.8	80.2
60.0	60.3	60.4	60.4	60.4	60.4	60.2	60.4	60.4	60.2	60.3	60.1	60.7
40.0	40.6	40.5	40.5	40.6	40.6	40.4	40.6	40.6	40.5	40.5	40.4	40.8
20.0	20.4	20.3	20.4	20.5	20.4	20.4	20.6	20.4	20.3	20.5	20.5	20.7

Note: (1) Standard gage indicated 99.9 psig

Table 12-1. Life Cycle Functional Test Data (Sheet 2 of 3)

Standard Gage Reading (psig) ±0.1% FS	Preceding Life Cycle Test	Cycles Completed										
		100	500	1000	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000
		Specimen 3 Gage Reading (psig, ±0.5% FS) S/N 6020005										
300	300	304	306	304	309	309	306	303	309	312	311	305
600	602	606	607	609	612	613	611	605	613	617	615	608
900	905	910	913	901	915	918	914	912	917	920	918	910
1200	1201	1205	1212	1209	1214	1217	1212	1211	1214	1217	1218	1208
1500	1500(1)	1500(2)	1500(2)	1500	1500(3)	1500	1500(4)	1500(5)	1500(4)	1500(6)	1500(7)	1500(2)
1200	1204	1208	1211	1200	1211	1213	1211	1205	1212	1215	1215	1209
900	906	910	912	901	914	917	913	907	916	918	916	912
600	605	609	609	598	609	610	609	604	610	614	611	610
300	301	302	302	292	303	305	303	302	305	307	310	305
		Specimen 4 Gage Reading (psig, ±0.5% FS) S/N 6020006										
300	300	302	303	304	305	308	302	302	305	309	308	300
600	607	610	611	612	614	619	612	606	614	619	617	608
900	907	913	913	902	915	917	912	910	912	918	917	908
1200	1201	1207	1209	1208	1211	1212	1207	1203	1209	1212	1212	1202
1500	1498	1500(1)	1500(1)	1492	1500(2)	1497	1500(8)	1500(8)	1500(9)	1500(2)	1500(4)	1498
1200	1204	1208	1209	1198	1209	1211	1208	1203	1206	1210	1210	1204
900	907	910	912	902	912	917	912	905	913	915	912	910
600	607	609	611	600	612	612	610	605	612	612	612	610
300	300	302	301	292	301	304	300	301	302	303	304	300

Note: Standard gage indications: (1) 1498 psig (2) 1494 psig (3) 1484 psig
(4) 1488 psig (5) 1490 psig (6) 1483 psig
(7) 1486 psig (8) 1495 psig (9) 1496 psig

Table 12-1. Life Cycle Functional Test Data (Sheet 3 of 3)

Standard Gage Reading (psig) ±0.1% FS	Preceding Life Cycle Test	Cycles Completed										
		100	500	1000	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000
	Specimen 5 Gage Reading (psig, ±0.5% FS) S/N 6020007											
2000	1925	2000	1970	2060	1980	2000	2000	2025	2025	2060	2080	2100
4000	3940	3990	3980	4100	3990	4010	4010	4045	4045	4090	4090	4130
6000	5925	5960	5960	6100	5990	6020	6020	6045	6090	6090	6140	6150
8000	7900	7960	7920	8070	7950	8000	8000	8010	8060	8140	8230	8200
10000	9900	9975	9945	10000(1)	9175(2)	9990	9990	9810(3)	9800(4)	9700(5)	9600(6)	9420(7)
8000	7960	8020	8000	8100	8010	8040	8050	8100	8100	8170	8230	8290
6000	6050	6080	6060	6140	6075	6080	6150	6120	6140	6200	6230	6280
4000	4050	4080	4075	4110	4075	4090	4200	4140	4100	4160	4200	4250
2000	2000	2025	2025	2060	2050	2060	2200	2090	2100	2110	2150	2200
	Specimen 6 Gage Reading (psig, ±0.5% FS) S/N 6020008											
2000	1900	1950	1900	2000	1925	1900	1900	2000	2025	2050	2100	2150
4000	3950	4010	3940	4050	3970	3975	4050	4025	4085	4150	4200	4330
6000	5900	6010	5910	6010	5940	5950	6000	6050	6110	6200	6300	6400
8000	7850	7875	7850	7980	7890	7940	7950	8040	8120	8290	8400	8600
10000	9900	9940	9880	10000	9100(2)	10000	1000	9955(3)	9950(4)	9950(5)	9950(6)	10000(7)
8000	7980	7940	7900	7975	7920	7970	8000	8145	8160	8320	8510	8760
6000	5980	5990	5975	6025	5980	6000	6050	6140	6170	6330	6450	6660
4000	4005	4010	4010	4040	4025	4040	4100	4145	4150	4290	4400	4540
2000	1950	1950	1940	1980	1960	1960	2040	2050	2060	2110	2200	2330

Note: Standard gage indication: (1) 9910 psig (2) 9200 psig (3) 9800 psig
(4) 9710 psig (5) 9500 psig (6) 9400 psig
(7) 9150 psig

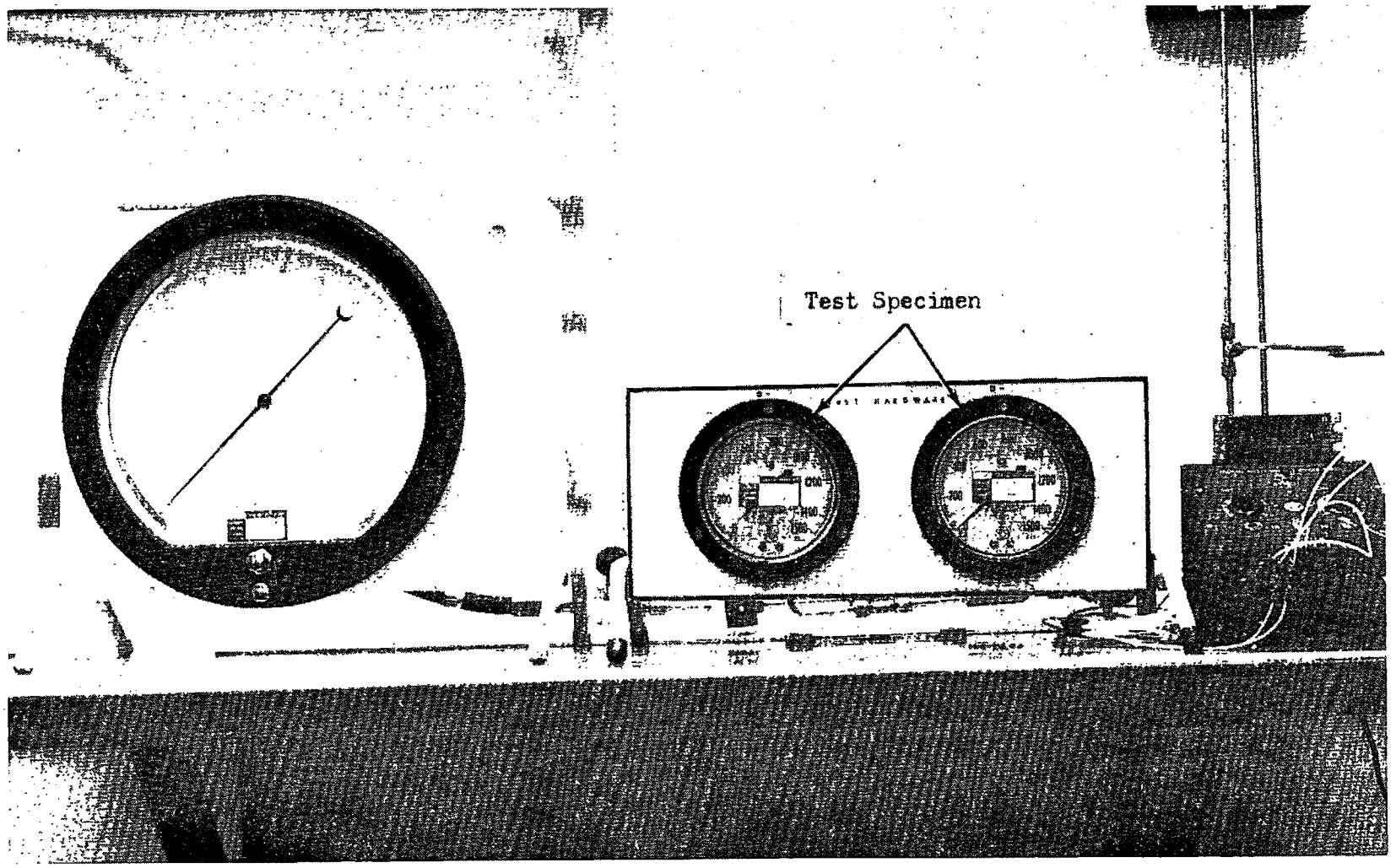


Figure 12-1. Cycle Test Setup

SECTION XIII

FINAL INSPECTION

13.1 TEST REQUIREMENTS

13.1.1 A visual inspection of test specimens 1, 2, 3, 4, 5, and 6 shall be made and any effects as a result of testing shall be noted.

13.2 TEST PROCEDURE

13.2.1 Test specimens 1, 2, 3, 4, 5, and 6 were visually inspected and any effects of testing were noted.

13.3 TEST RESULTS

13.3.1 The pointers on gages 1 and 2 did not return to zero. No adjustment was made.

13.3.2 All test specimens showed signs of corrosion internally and externally.

SECTION XIV

BURST PRESSURE TEST

14.1 TEST REQUIREMENTS

14.1.1 Test specimens 1 and 2 shall be subjected to a hydrostatic pressure of 250 psig for five minutes.

14.1.2 Test specimens 3 and 4 shall be subjected to a hydrostatic pressure of 3750 psig for five minutes.

14.1.3 Test specimens 5 and 6 shall be subjected to a hydrostatic pressure of 15,000 psig for five minutes.

14.1.4 The gages shall be inspected for leakage and structural damage.

14.1.5 Test specimens 1, 2, 3, 4, 5, and 6 shall be pressurized until rupture occurs. The burst pressure shall be recorded.

14.2 TEST PROCEDURE

14.2.1 The test specimens were placed in a burst test setup as shown in figures 14-1 and 14-2 using the equipment listed in table 14-1. Test specimen 1 was installed into the setup.

14.2.2 All hand valves were closed and regulator 21 was adjusted for zero outlet pressure.

14.2.3 Hand valves 6, 7, 8, 9, 10, 11, and 24 were opened to fill the specimen and system with water. Fittings were loosened at the test specimen and at gages 3 and 23 as required to bleed all air from the system.

14.2.4 Hand valves 6, 8, 9, and 11 were closed.

14.2.5 Hand valve 5 was opened. Gage 14 indicated 3000 psig.

14.2.6 Switch 17 was closed to open solenoid valve 18.

14.2.7 Regulator 21 was adjusted to provide a pressure of 50 to 100 psig as indicated on gage 15. Pump 19 began operating.

14.2.8 The pump was continuously operated until the specimen pressure as indicated by gage 3 was 250 psig. Solenoid valve 18 was closed by opening switch 17 to stop the pump.

14.2.9 250 psig was maintained to the test specimen for 5 minutes.

14.2.10 Solenoid valve 18 was opened by closing switch 17 to resume pumping. The pump was continuously operated until the specimen was pressurized to rupture. The rupture pressure was recorded.

14.2.11 Steps 14.2.2 through 14.2.10 were repeated after replacing specimen 1 with specimen 2.

14.2.12 Test specimen 2 was replaced by specimen 3.

14.2.13 Steps 14.2.2 through 14.2.7 were repeated.

14.2.14 The pump was continuously operated until the specimen pressure as indicated by gage 3 was 3750 psig. Solenoid valve 18 was closed by opening switch 17 to stop the pump.

14.2.15 3750 psig pressure was maintained to the test specimen for 5 minutes.

14.2.16 Step 14.2.10 was repeated. Hand valve 24 was closed when gage 3 was pressurized to approximately 95% of full scale.

14.2.17 Steps 14.2.13 through 14.2.16 were repeated after replacing specimen 3 with specimen 4. Hand valve 24 was closed.

14.2.18 Steps 14.2.2 through 14.2.7 were repeated.

14.2.19 The pump was continuously operated until the specimen pressure as indicated by gage 23 was 15,000 psig. Solenoid valve 18 was closed by opening switch 17 to stop the pump.

14.2.20 15,000 psig pressure was maintained to the test specimen for 5 minutes.

14.2.21 Step 4.2.10 was repeated.

14.2.22 Steps 14.2.18 through 14.2.21 were repeated after replacing specimen 5 with specimen 6.

14.2.23 All test data were recorded.

14.3 TEST RESULTS

14.3.1 All specimens satisfied the minimum burst pressure requirements without leakage or evident structural damage.

14.3.2 Figure 13-3 shows the typical area of rupture observed following the burst test.

14.4 TEST DATA

The burst test data are presented in table 14-2.

Table 14-1. Burst Pressure Test Equipment List

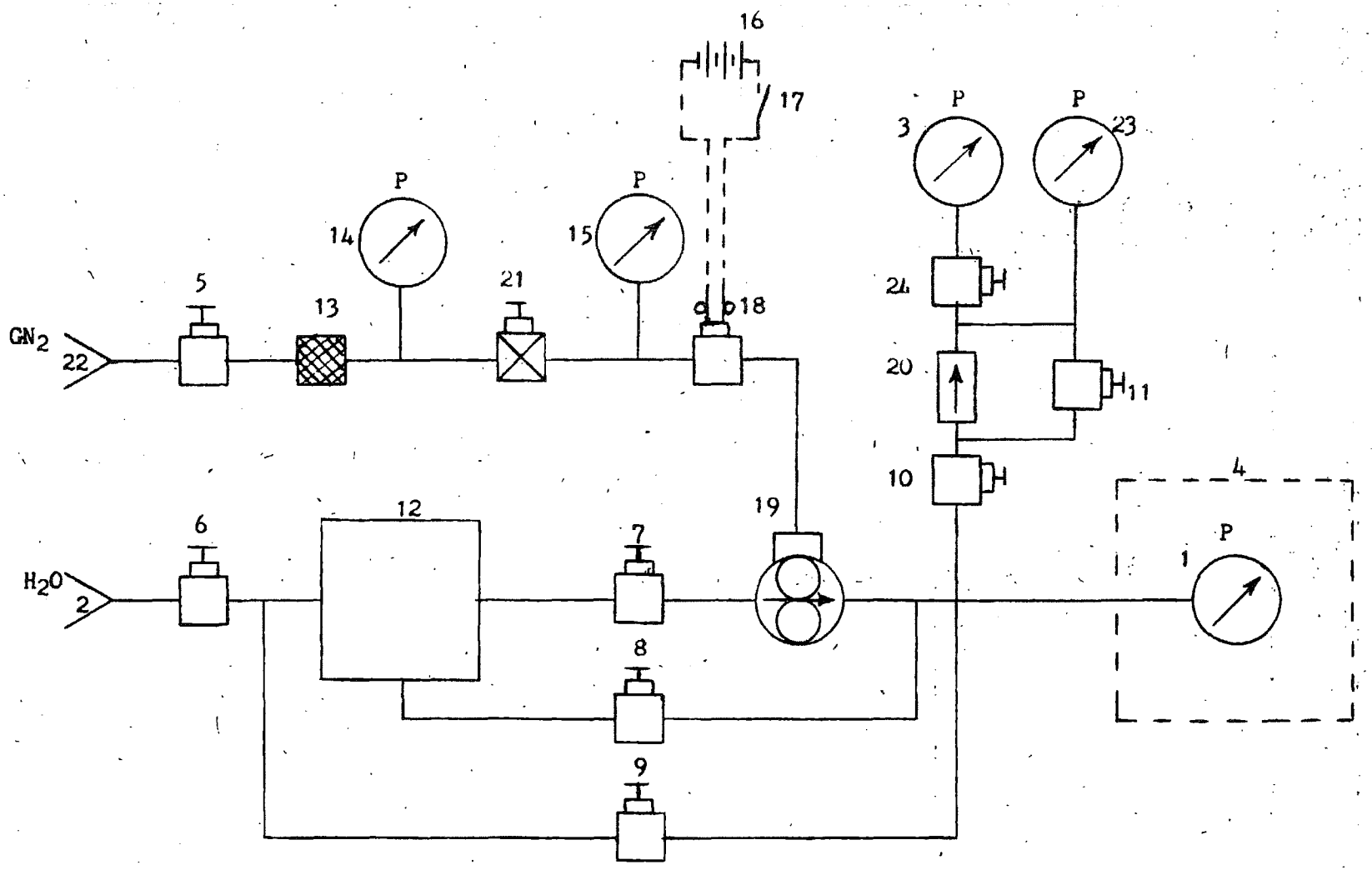
Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956D	6020001 6020003	0-to 100-psig ±.5% FS
	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956M	6020005 6020006	0-to 1500-psig ±.5% FS
	Gage, Pressure 4.5-Inch (Test Specimen)	Helicoid Gage Div.	3956T	6020007 6020008	0-to 10,000-psig ±.5% FS
2	Water Supply	NA	NA	NA	Tap water
3	Hydrostatic Pressure Gage	Ashcroft		NASA 08113 95-1396-B	0-to 10,000-psig ±.5% FS Cal. date: 10/19/66
4	Burst Chamber	CCSD	NA	201344	3' X 3' X 3'
5	Hand Valve	Aminco	58965	NA	¼-Inch
6	Hand Valve	Aminco	58965	NA	¼-Inch
7	Hand Valve	Aminco	58965	NA	¼-Inch
8	Hand Valve	Aminco	58965	NA	¼-Inch
9	Hand Valve	Aminco	58965	NA	¼-Inch
10	Hand Valve	Aminco	58965	NA	¼-Inch
11	Hand Valve	Aminco	58965	NA	¼-Inch
12	Water Reservoir	NA	NA	NA	2-gallon
13	Pneumatic Filter	Bendix Filter Div.	Element No. 1731260	NA	2-micron
14	Pneumatic Gage	U. S. Gage	8990	NA	0-to 5000-psig ±2% FS Uncalibrated reference

Table 14-1. Burst Pressure Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
15	Pneumatic Gage	Ashcroft	AMP 7324	NA	0-to 300-psig ±2% FS Uncalibrated reference
16	Power Supply	Meletron	Cat. # 13300-60A	NA	28-vdc
17	Switch	NA	NA	NA	SPST
18	2-Way Solenoid Valve	Marotta Valve Company	MV-100D	NA	Normally closed
19	Hydrostatic Pump	Sprague Engine Corp.	NA	300-16 -64	Air operated Max. pressure 50,000 psig
20	Check Valve	Aminco	Cat. # 44-6305	NA	¼-Inch
21	Regulator	Marotta Valve Corp.	219004-C121	NA	3000-psig inlet, 0-to 125-psig outlet
22	Pneumatic Pressure Supply	CCSD	NA	NA	3000-psig
23	Pressure Gage	Astra	NA	NASA No. 011893-A	0-to 10,000-psig ±1% FS Cal. date: 11/3/66
24	Hand Valve	Aminco	58965	NA	¼-Inch

Table 14-2. Burst Test Data

Specimen	Minimum Burst Pressure (psig)	Rupture Pressure (psig)
1	250	6300
2	250	5100
3	3750	22500
4	3750	20000
5	15000	18000
6	15000	18500



Note: All lines ¼ inch.
Refer to table 14-1 for item identification.

Figure 14-1. Burst Test Schematic

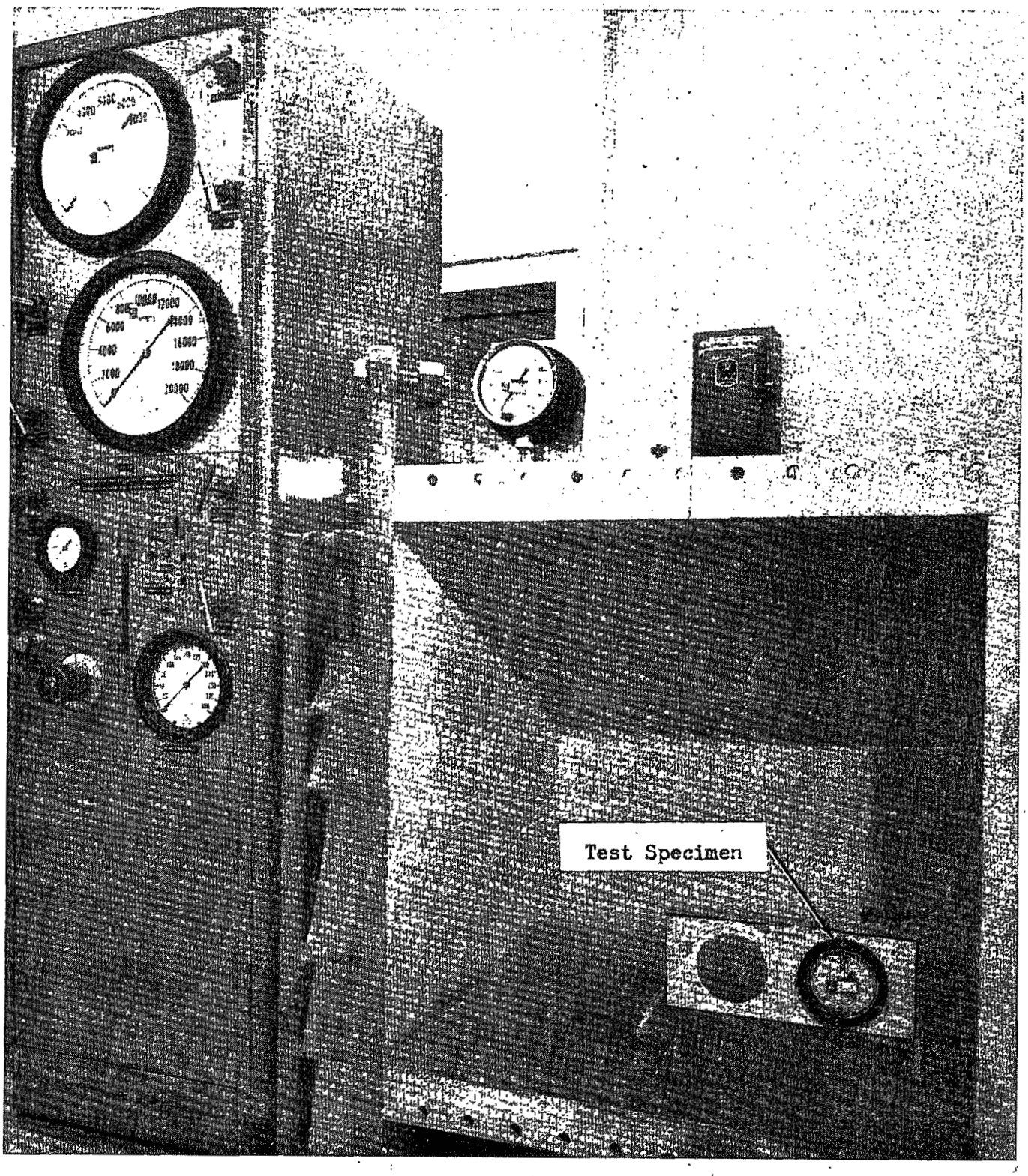


Figure 14-2. Burst Test Setup

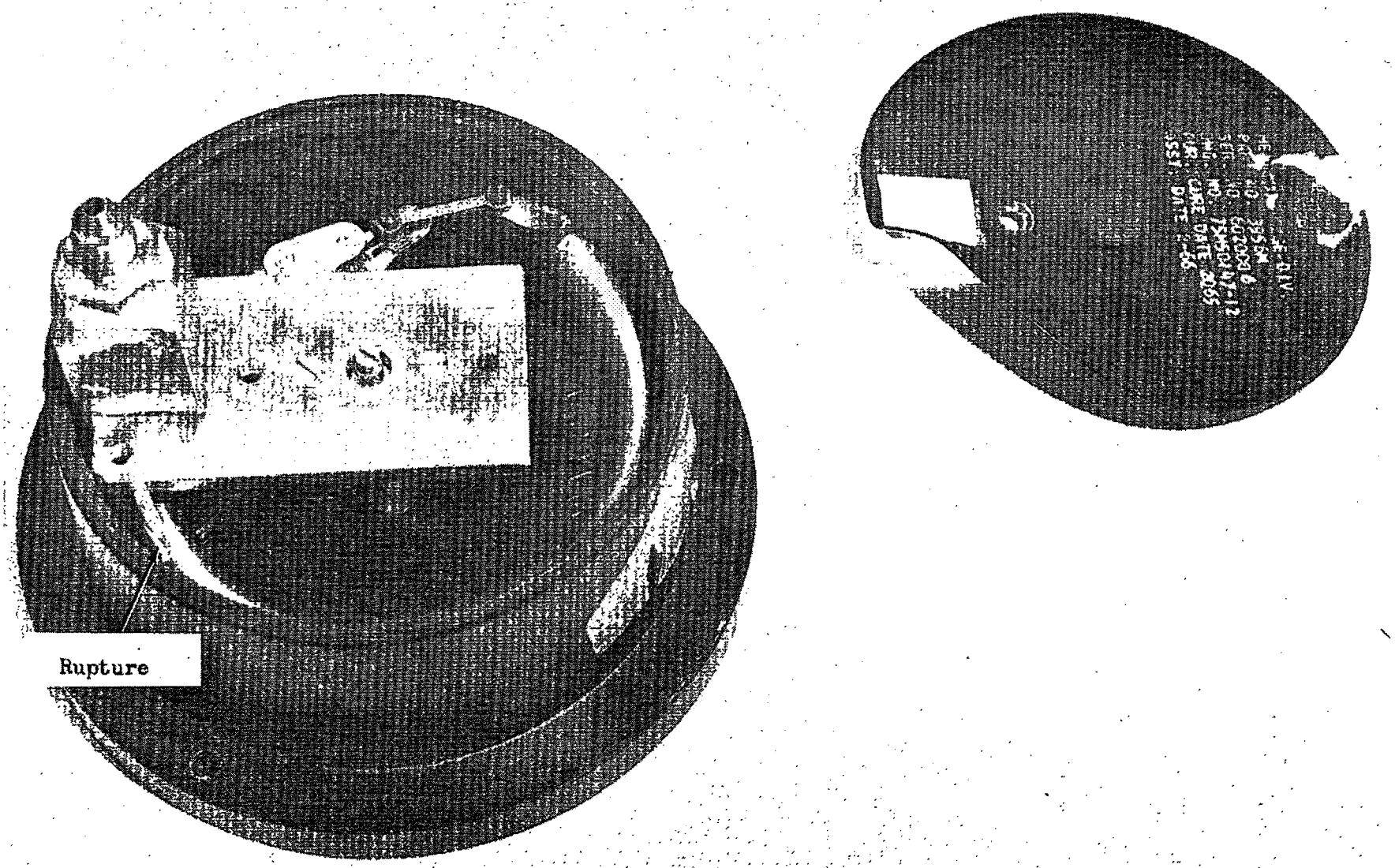


Figure 14-3. Typical Area of Rupture After Burst Test

APPROVAL

TEST REPORT

FOR

PRESSURE GAGES, 4.5-INCH

Helicoid Gage Division, American Chain and Cable Co.

Part Numbers 3956D, 3956M, and 3956T

Replacements For

NASA Drawing Numbers 75M50147-4

75M50147-12 and 75M50147-18

SUBMITTED BY:

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